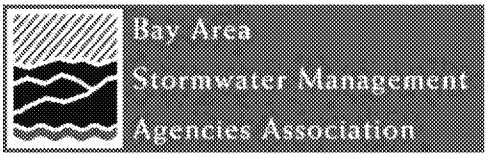
Receiving Water Trash Monitoring Program Plan for the San Francisco Bay Region

Version 1.0

Submitted in compliance with Provision C.10.b.v of Order No. R2-2015-0049

Prepared by:



Prepared for:

Permittees subject to the San Francisco Bay Area Municipal Regional Stormwater NPDES Permit Order No. R2-2015-0049

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Preface

Version 1.0 of this Receiving Water Trash Monitoring Program Plan, including the monitoring design and monitoring/assessment protocols, was based on a review of existing methodologies that have been used to monitor trash in receiving waters and significant input from Peer Reviewers, MRP Permittees, San Francisco Bay Regional Water Quality Control Board staff, and other stakeholders. The Plan is intended to begin addressing trash management questions posed in the MRP. The Plan recognizes that methodologies and protocols to accurately measure or assess baseline trash levels, pathways and sources, and trends in receiving waters are not well established. Therefore, this initial version (1.0) of the Trash Monitoring Plan should be considered preliminary and will be adapted based on lessons learned during the initial implementation phase (October 2017 – July 2020) to help guide future trash monitoring in San Francisco Bay Area receiving waters. The Plan was developed by EOA, Inc., Geosyntec, and Larry Walker Associates (LWA) for the Bay Area Stormwater Management Agencies Association (BASMAA) on behalf of all MRP Permittees.

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1. Introduction

1.1. WATER QUALITY CONCERNS ABOUT TRASH IN THE SAN FRANCISCO BAY AREA

The San Francisco Bay Regional Water Quality Control Board (Regional Water Board) has determined that trash[1] is a pervasive problem near and in receiving waters, such as local creeks, rivers, and the San Francisco Bay Estuary (SFBRWQCB, 2015). Trash can cause major impacts to beneficial uses, including recreation, aquatic life and habitat in those waters. Trash can originate on land or through individuals directly dumping/depositing trash into a receiving water or on its banks/shoreline. Eventually, trash present in local water bodies contributes to the global ocean ecosystem, where it can persist in the environment for hundreds of years, concentrate organic toxins, and be ingested by aquatic life. There are also physical impacts, as aquatic species can become entangled and ensnared, and can ingest plastic that looks like prey, losing the ability to feed properly.

Between 2003 and 2005, trash levels and types deposited in local creeks and rivers were measured by the Regional Water Board using the Surface Water Ambient Monitoring Program's (SWAMP) Rapid Trash Assessment (RTA) Protocol. The Regional Water Board reported that data collected by SWAMP indicated that levels of trash in the waters of the San Francisco Bay region were very high (SFBRWQCB, 2007). During 85 surveys conducted at 26 sites throughout the Bay Area, an average of almost three pieces of trash were observed per linear foot of creek. As a result of this new information, the Regional Water Board added 26 waterbodies in the region to the 303(d) list for the pollutant trash and concluded that this set of receiving waters was representative of the trash impacts present in all segments of local receiving waters that flow through urbanized watershed areas, and the shoreline of San Francisco Bay (Bay). Additionally, urban stormwater runoff was identified as an important pathway that transports trash from watersheds to these receiving waters. Identifying stormwater as an important pathway necessitated the inclusion of trash load reduction requirements in the Municipal Regional Stormwater NPDES Permit (MRP 2.0), Order No. R2-2015-0049 (see below).

1.2. MUNICIPAL REGIONAL STORMWATER PERMIT

MRP 2.0 was issued by the Regional Water Board on November 19, 2015 to 76 cities/towns, counties and special districts (Permittees). MRP 2.0 includes general stormwater management requirements, as well as those associated with specific pollutants. Provision C.10 of MRP 2.0 (Trash Load Reduction) requires Permittees to reduce trash discharged from their municipal separate storm sewer system (MS4) by demonstrable amounts in specific timeframes, install and maintain trash full capture systems, annually cleanup and assess trash hot spots in receiving waters, and conduct monitoring and assessment activities to address specific management questions regarding trash. Provision C.10.b.v entitled "Receiving Water Monitoring" (see **Attachment 1**) requires Permittees to develop and test a receiving water trash monitoring

[1] The MRP defines trash, litter and particles of litter. Manmade litter is defined in California Government Code section 68055.1(g): Litter means all improperly discarded waste material, including, but not limited to, convenience food, beverage, and other product packages or containers constructed of steel, aluminum, glass, paper, plastic, and other natural and synthetic materials, thrown or deposited on the lands and waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling, or manufacturing.

program plan (Trash Monitoring Program Plan). The Trash Monitoring Program Plan must include the following:

i. Description of the tools and protocols;
ii. Description of discharge and receiving water scenarios, which will be considered, that accounts for the various receiving waters and watershed, community, and drainage characteristics within Permittees' jurisdictions that affect the discharge of trash and its fate and effect in receiving water(s);
iii. Description of factors, in addition to those in C.10.b.v.a.(ii), that will be considered and evaluated to determine scenarios and spatial and temporal representativeness;
iv. Identification of sites, representative of all the Permittees and discharge and receiving water scenarios, that will be monitored during this permit term;
v. Development of a system to manage and access monitoring results;
vi. Opportunity for input and participation by interested parties;
vii. Scientific peer review of the tools and protocols and testing results; and
viii. Schedule for development and testing; with monitoring at representative sites starting no later than October 2017.[2]

The overall goal of the Trash Monitoring Program Plan, as described in the MRP 2.0 Fact Sheet, is to establish:

> *"...the least expensive and simplest to use monitoring methods and protocols that are applicable to the various discharge and receiving water scenarios that accounts for the various receiving waters and watershed, community, and drainage characteristics within Permittees' jurisdictions that affect the discharge of trash and its fate and effect in receiving water(s). These and other factors, such as feasibility, location logistics, types of trash, complexity, and costs provide a means to focus and limit the number of monitoring tools and protocols, and determine spatial and temporal representativeness of the tools and protocols, representativeness of scenarios that will be tested."* (Emphasis added)

The Fact Sheet also indicates that Permittees may include assessment methods based on the *Rapid Trash Assessment Method Applied to Waters of the San Francisco Bay Region: Trash Measurement in Streams* (SFBRWQCB, 2007). Additionally, MRP 2.0 specifies that the development of receiving water monitoring tools and protocols and a monitoring program shall be designed, to the extent possible, to answer the following management questions:[3]

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[2] The MRP states that if the Permittees conduct this work through an independent third party, approved by the Executive Officer, the Plan may be submitted by July 2018, with monitoring to begin no later than October 2018.

[3] It is important to note that the requirements associated with Receiving Water Trash Monitoring were added to MRP 2.0 at the very end of the public hearing where the permit was adopted. Therefore, very limited time was allotted to Permittees to evaluate and respond to the monitoring requirements and the management questions listed here. During the development of this Monitoring Program Plan, Permittees have initially evaluated these questions and identified many issues with their wording and intent, and determined that the questions should be evaluated and revised accordingly prior to the issuance of MRP 3.0. To the extent possible, this Monitoring Program Plan attempts to address these questions in a practical and feasible manner that is appropriate.

1. Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s)?
2. Is trash present in receiving water(s), including transport from one receiving water to another, e.g., from a creek to a San Francisco Bay segment, at levels that may cause adverse water quality impacts?
3. Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?
4. Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?

In parallel to receiving water trash monitoring required by MRP 2.0, receiving water monitoring is also discussed in the statewide "Trash Amendments", recently adopted by the State Water Resources Control Board (State Water Board). Two statewide water quality control plans were amended through this action to include trash control requirements for owners/operators of MS4s. Management questions identified in the Trash Amendments are compared to those included in MRP 2.0 later in this document. Additionally, coordination efforts underway that are intended to address information needs of both regulatory actions are also discussed.

1.3. RECEIVING WATER TRASH MONITORING PROGRAM PLAN

This Trash Monitoring Program Plan was developed by the Bay Area Stormwater Management Agencies Association (BASMAA) on behalf of Permittees and in compliance with MRP 2.0 provision C.10.b.v. The Monitoring Program Plan describes the initial receiving water trash monitoring program that addresses the four questions listed in the previous section and is designed to provide regionally consistent data on the extent and magnitude of trash in receiving waters, the dominant sources of trash, and whether trash management actions are reducing these sources/levels. Consistent with MRP 2.0, the Monitoring Program Plan represents "Version 1.0" or the "testing phase" of the Trash Monitoring Program implementation, during which the protocols and methods included will be evaluated in the field. This evaluation will provide Permittees the opportunity to evaluate the validity of proposed monitoring protocols and adapt the methodologies for future iterations of the monitoring program based on the information gained during the MRP 2.0-specified timeframe of October 2017 to July 2020.

The monitoring design, protocols and methods included in this Plan are based on a review of historical and current receiving water monitoring efforts for trash (see **Attachment 2**) and in consideration of parallel efforts that are currently underway by the State Water Resources Control Board (State Water Board) to evaluate and test methodologies for trash monitoring in receiving waters.[4] The Plan was developed with significant input from Permittees, stakeholders (e.g., Regional and State Water Board staff and non-governmental environmental groups) and

[4] Based on Bay Area Permittee and stormwater program staff participation in a 3-day workshop (April 17-19, 2017), coordinated by the Ocean Protection Council on behalf of the State Water Resources Control Board, that was aimed at developing a trash monitoring conceptual model, it is our understanding that the State Water Board is beginning a 2-year trash monitoring methods evaluation, which will provide additional perspective on methods and protocols for receiving water trash monitoring that are both practical and reproducible. See Section 2.2 for additional information.

technical advisors/peer reviewers. Additionally, protocols and methods included in this Plan were developed/selected in consideration of the language included in the MRP 2.0, which states that the "…monitoring tools and protocols shall include direct measurements and/or observations of trash in receiving waters, or in scenarios where direct measurements or observations are not feasible, surrogates for trash in receiving waters, such as measurement or observations of trash on stream banks or shorelines."

2. Background

2.1. MONITORING PROGRAM PLAN DEVELOPMENT PROCESS

BASMAA is a non-profit organization of the municipal stormwater programs in the San Francisco Bay Area[5] whose purpose is to coordinate and facilitate regional activities for the municipal stormwater programs, focusing especially on regional challenges and collaborative opportunities to meet stormwater program requirements. This Monitoring Program Plan was developed through a collaboration of the BASMAA Project Management Team (PMT), regional stakeholders, and scientific peer reviewers, as described below.

2.1.1. Project Management Team

BASMAA convened a Project Management Team to guide the development of a collaborative, regional receiving water trash monitoring program. The PMT consisted of representatives from most of the BASMAA agencies (**Table 2-1**), many with experience in conducting water quality monitoring and trash monitoring in receiving waters.

Table 2-1. BASMAA Project Management Team

PMT Member	Agency/Program
Geoff Brosseau, Project Manager	Bay Area Stormwater Management Agencies Association (BASMAA)
Beth Baldwin, Assistant Project Manager	Contra Costa Clean Water Program (CCCWP)
Jim Scanlin	Alameda County Clean Water Program (ACCWP)
Kristin Hathaway and Ben Livsey	City of Oakland / ACCWP
Doug Scott and Jennifer Harrington	Vallejo Sanitation and Flood Control District (VSFCD)
Chris Sommers and Paul Randall	Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
Sharon Newton, Jennifer Seguin and Liz Neves	City of San Jose / SCVURPPP
Reid Bogert and Matt Fabry	San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
Sarah Scheidt and Grant Ligon	City of San Mateo / SMCWPPP
Kirsten Struve, Carole Foster and Jennifer Castillo	Santa Clara Valley Water District (SCVWD)

2.1.2. Stakeholder Process

Prior to beginning the project, Permittees and Regional Water Board staff were queried to develop a robust list of stakeholders who would be potentially interested in providing feedback on the Monitoring Program Plan. Based on this query and participation from specific stakeholders on recent trash-related projects, a diverse set of stakeholders were engaged throughout the Monitoring Program Plan development process. Stakeholders included additional

[5] Alameda Countywide Clean Water Program; Contra Costa Clean Water Program; Fairfield-Suisun Urban Runoff Management Program; Marin County Stormwater Pollution Prevention Program; Napa Countywide Stormwater Pollution Prevention Program; San Mateo Countywide Water Pollution Prevention Program; Santa Clara Valley Urban Runoff Pollution Prevention Program; Sonoma County Water Agency; and Vallejo Sanitation and Flood Control District.

Permittee representatives, and staff from environmental non-governmental organizations, US EPA, and Regional and State Water Boards. A list of stakeholders that participated in the Monitoring Program Plan development is included in **Attachment 3**.

Efforts to develop the Monitoring Program Plan were designed to maximize the opportunity for stakeholders' participation. BASMAA held three stakeholder meetings at key stages of the project to solicit input and share information (**Table 2-2**). Additionally, stakeholders also had an opportunity to contribute information on existing monitoring tools and protocols through a survey process conducted by the PMT in October and November 2016.

Table 2-2. Stakeholder Meeting Dates and Topics

Meeting Date	Key Discussion Topics
October 25, 2016	Review of Monitoring Program Goals and existing tools
January 31, 2017	Review of existing tools, tool prioritization, initial sample locations, and development of recommended tools
June 12, 2017	Review of Draft Monitoring Program Plan, including monitoring tools and protocols and data management systems/procedures

Input received during stakeholder meetings was recorded and detailed in written meeting summaries (see **Attachment 3**). Stakeholders were also provided the opportunity to review and provide comments on the Draft Monitoring Program Plan. The PMT discussed and reviewed all stakeholder comments and addressed them as necessary. In some instances, follow-up discussions were necessary with individual stakeholders (e.g., Regional Water Board staff) to obtain clarification and guidance for moving forward with the project. A table of stakeholder comments received and BASMAA responses is included as **Attachment 8**.

In addition to the input received from stakeholders, in July 2017 Regional Water Board staff provided written comments on the Monitoring Program Plan. The BASMAA Project Management Team reviewed the comments and formed responses to comments received. Additionally, BASMAA representatives met with Water Board staff to reconcile remaining questions and concerns. **Attachment 9** includes Regional Water Board comments and BASMAA's responses. This version of the Monitoring Program Plan incorporates revisions identified in the BASMAA response to comments table.

2.1.3. Peer Review of Monitoring Program Plan

The development of this Monitoring Program Plan utilized technical experts to review the monitoring tools, protocols and sample design. These peer reviewers were selected by the PMT based on their experience in designing and implementing trash receiving water monitoring programs and/or or types of water quality monitoring. Peer reviewers provided input on key topic areas where input was needed to develop a successful receiving water trash monitoring program. The peer reviewers that participated in the project were:

Shelly Moore. Ms. Moore is an Information Research Scientist as part of the Information Management and Analysis Group at the Southern California Coastal Water Research Project

(SCCWRP). Ms. Moore specializes in transforming environmental data into usable information through her expertise in data management, data analysis, and data visualization and her background in biology. Her present efforts focus is on developing data management systems and web-based/desktop data analysis and visualization applications to assist SCCWRP's member agencies, environmental managers and scientists in making informed decisions to better manage aquatic resources. Ms. Moore is experienced in conducting rapid trash assessments and qualitative visual assessments. Her experience also includes developing protocols and designing water quality monitoring programs.

Dr. Sherry Lippiatt. Dr. Lippiatt is the Regional Coordinator for the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program for California. Her work with NOAA includes coordinating and leading a nationwide citizen science effort, the "Marine Debris Monitoring and Assessment Project," overseeing and providing support to marine debris related projects, activities, and actions in California, developing and maintaining strategic partnerships and effective communications with government, industry, academic, and non-profit organizations, reviewing grant proposals for marine debris research, removal, and conducting outreach for federal funding opportunities, providing expertise and coordination for response to severe marine debris events, and initiating and participating in Congressional briefings and outreach opportunities in the region related to marine debris. Dr. Lippiatt is experienced in developing and implementing depositional (shoreline) and open water trash monitoring programs, including protocol development.

Dr. Aroon Melwani. Dr. Melwani is a Senior Scientist at Applied Marine Sciences, Inc., with over 16 years of experience in the design and implementation of water quality monitoring and research. He has provided technical guidance and support to agencies throughout the San Francisco Bay Area in studies of fish, water, and sediment contamination, wetland assessments, and stormwater. Dr. Melwani is currently working as the principal investigator for a project optimizing the design of small tributaries stormwater monitoring studies for trends in the Bay Area. Previously serving as Environmental Scientist to the Regional Monitoring Program for Water Quality in San Francisco Bay (2004-2011), Dr. Melwani has been involved in the evaluation and optimization of several water quality assessment tools and methodologies, including developing probabilistic sample frames to monitor creeks at the regional scale.

Peer reviewers were asked to assist in the review of the draft version of this Trash Monitoring Program Plan. In addition, many of the monitoring tools and protocols reviewed during the development of, and incorporated into, the Trash Monitoring Plan, underwent previous scientific peer review (i.e., prior to this project). Communications with peer reviewers were conducted mainly via email and telephone calls. Peer reviewers were also sent pertinent meeting summaries and questions to focus their review of project documents. A table of peer reviewer comments received and BASMAA responses is included as **Attachment 8**. In the future, peer reviewers will be consulted to assist with the evaluation and interpretation of data collected through the Monitoring Program Plan.

2.2. CONSISTENCY AND COORDINATION WITH STATEWIDE TRASH POLICY AND OTHER CONCURRENT TRASH MONITORING PROJECTS

2.2.1. OPC/State Water Board Trash Monitoring Methods Evaluation

On April 7, 2015, the State Water Board adopted Amendments to the *Water Quality Control Plan for Ocean Waters of California (Ocean Plan)* and *Part 1 Trash Provision of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries* (ISWEBE Plan) to control trash in receiving waters. These "Trash Amendments" are not directly applicable[6] to MRP Permittees since trash requirements are included in MRP 2.0, however they do include questions that may best be addressed via receiving water trash monitoring. In response to the possible need for receiving water monitoring methods, the Ocean Protection Council (OPC), in collaboration with the State Water Board, SCCWRP and San Francisco Estuary Institute (SFEI), is coordinating an evaluation and testing of trash monitoring methods for receiving waters. This three-year effort is intended to provide additional perspective and recommendations on monitoring methods that are both practical and reproducible.

During the implementation of the Bay Area Trash Monitoring Program Plan, BASMAA member agencies and Permittees plan to continue tracking the OPC's efforts and to the extent possible will actively participate in the coordinated testing of trash monitoring methods. In an effort to begin aligning these efforts, the questions posed in MRP 2.0 and the Statewide Trash Amendments were compared (see **Attachment 4)**. OPC's project is currently scheduled to begin in late 2017 (*personal communication with project manager*).

2.2.2. Microplastics Monitoring Method Development

In early 2017, a two-year investigation began on better understanding the sources, transport and fate of microplastics and nanoplastics in San Francisco Bay and the surrounding ocean. The project is led by SFEI in coordination with the 5 Gyres Institute. The project will provide the most comprehensive study in the U.S. on microplastic and nanoplastic levels in water, sediment, and fish and explore ways to reduce impacts. The project is funded by the Gordon and Betty Moore Foundation with additional support from the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP). The project is consistent with the RMP's microplastic strategy that was also completed in early 2017.

A major scientific component of the micro/nanoplastics project is to develop monitoring methods and standards, which can help inform future monitoring conducted. BASMAA member agencies plan to actively participate in the project through their participation in the RMP and its workgroups, with the goals of providing input on the methods development process and gaining a better understanding of the applicability of the methods being developed via the project to "macro" trash monitoring being conducted by BASMAA member agencies. This on-going in-kind participation will be in addition to the funding provided to the project by BASMAA member agencies via contributions to the RMP.

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[6]Requirements in the San Francisco Bay Area's Municipal Regional Permit need to be consistent with the State Board's Trash Amendments.

2.3. OVERALL GOALS OF THE TRASH MONITORING PROGRAM

Specific goals of the Trash Monitoring Program were developed and refined through the stakeholder engagement process to cost-effectively answer the MRP 2.0 monitoring questions (**Table 2-3**). The following were considered in the development of these goals:

- Optimization of the monitoring questions in terms of allocation of resources and effort;
- In-stream monitoring versus shoreline surrogate monitoring (and/or potentially outfall monitoring);
- Capturing the representativeness of various receiving water types (small/large, riparian/channelized), watershed characteristics, and sources of trash;
- Seasonal, spatial, and temporal trends;
- Statistical sampling design requirements (degree of confidence, power analysis);
- General metrics to be measured (e.g., trash density, mass, volume, item counts and/or classifications);
- Nexus with current on-land monitoring activities; and
- Quality assurance/quality control.

Table 2-3. Overall Goals of the Receiving Water Trash Monitoring Program.

Refined Receiving Water Monitoring Questions[7]	Monitoring Program Goals							
	Informs management decisions	Accounts for different stream and channel types, and considers temporal variability (e.g., to estimate baseline conditions and show change over time) and seasonality	Can assess trends over time	Helps to assess if the Permittees' trash reduction efforts are resulting in improvement, over time	Allows for comparison of trash levels between sites (understand the range of levels of impact)	Assists in determining relative contributions from different pathways (i.e., wind, illegal dumping, illegal encampments, MS4s).	Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e)	Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups)
1. Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts?	✓	✓	✓	✓	✓		✓	✓
2. Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s) (*over time*)?	✓		✓	✓	✓	✓	✓	✓
3. Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?	✓	✓	✓	✓	✓	✓	✓	✓
4. Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?	✓	✓	✓			✓	✓	✓
5. Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	✓	✓	✓		✓			✓

[7] The four questions posed in MRP 2.0 were split into the following five questions to design the Monitoring Program Plan.

3. Monitoring Design

3.1. RECEIVING WATER TYPES AND COMPONENTS

The types of waterbodies that may be of interest to San Francisco Bay Area Permittees, scientists and stakeholders for trash monitoring and impacts include:

- Lotic (flowing) waterbodies, such as creeks, channels and rivers;
- Lentic (still) waterbodies, such as lakes, reservoirs and lagoons;
- San Francisco Bay Estuary segments and tidal wetlands; and
- The Pacific Ocean coastline.

These waterbodies represent extremely large areas and lengths of fresh, estuarine and marine habitats that could be important parts of a trash monitoring program. For example, there are over 3,500 miles of creeks, rivers and channels, and more than 100 lakes and reservoirs in the Bay Area. The San Francisco Bay shoreline is over 200 miles in length and the surface area of the Bay and its tidal wetlands are roughly 1,500 mi^2. The SF Bay region also includes over 150 miles of the Pacific Ocean coastline.

Due to the lack of monitoring programs focused on trash, the collective knowledge of Permittees, scientists, regulators and other stakeholders in the Bay Area about the levels of trash and the associated impacts in each receiving water type is limited. These information gaps have created a need for data on the current levels of trash in receiving waters and the importance of different trash sources and pathways. Adding to the lack of information about the levels of trash in different waterbody types, there are many components or habitats within a receiving water that could be monitored. Trash can be present in the water column itself, on the surface or within the substrate of the waterbody, or deposited on its banks or shorelines. Depending on the proximity to sources, the characteristics of the habitat, and the timing of the monitoring, trash will likely be observed at varying levels in these different components. Similar to the different type of waterbodies, the collective scientific knowledge about the levels of trash in each component/habitat of a water body (over space and time) is lacking.

Developing a comprehensive monitoring program that addresses all information needs associated with all receiving water types and components/habitats is a daunting task that is well beyond the scope of this Trash Monitoring Program Plan. Recognizing this, the Project Management Team (PMT), in consultation with Regional Water Board staff, has prioritized the types and components of waterbodies that will be addressed through implementation of version 1.0 of the Plan. Prioritization was based on a review of the questions posed in MRP 2.0, the established monitoring program goals, and the practicality of implementing a trash monitoring program that meets the spirit of the MRP requirements.

Based on the prioritization process, the testing phase of this Monitoring Program Plan (October 2017-July 2020) will primarily focus on evaluating the extent, magnitude and pathways of trash present/deposited on the surface and banks of lotic waterbodies (e.g., creeks, channels, rivers) and the shorelines of SF Bay and the Pacific Ocean (**Table 3-1**). Focusing this initial phase

(Phase I) of the Trash Monitoring Program on trash deposited in lotic waterbodies and shorelines will also assist Permittees and the Regional Water Board in evaluating the relative contributions from MS4s and other trash pathways, and the effectiveness of controls currently in place. Lessons learned from this testing phase, along with information gained through the OPC/State Water Board trash monitoring methods evaluation, will be used to refine and redirect future trash monitoring and assessment in the Bay Area.

Table 3-1. Receiving water types and components/habitats that will be addressed through the testing (Phase I) of the Trash Monitoring Program Plan.

Receiving Water Type	Component				
	Water		Substrate		Banks, Shorelines and Beaches
	Surface	Column	Surface	Bedded	
Lotic (flowing) Waterbodies (e.g., creeks, channels and rivers)	✓	*			✓
Lentic (still) Waterbodies (e.g., lakes, reservoirs and lagoons)	✓				✓
SF Bay Estuary & Tidal Wetlands					✓
Pacific Ocean					✓

* The BASMAA's *Tracking California's Trash* study that was completed in 2017 evaluated different methods to measure trash levels transported in flowing waterways during storm events. The study was conducted as a proof of concept and was not expected to generate reliable data on trash "flux" in the column of flowing receiving waters. Study findings identified several constraints to conducting trash monitoring in flowing waterbodies during storm events, including the lack of suitable sites (e.g., bridges with access, permit for monitoring, nearby flow gauge), permitting, safety and costs. Additionally, the monitoring data collected was of limited use in answering questions about the transport of trash from one water body to another, mostly due to the constraints listed above. Therefore, because of the impracticality and high costs of collecting data that will likely be unusable and not assist BASMAA in answering MRP management questions, water column monitoring is not included in this BASMAA Trash Monitoring Program Plan. As an alternative to trash "flux" or water column monitoring, BASMAA member agencies will include quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons to better understand the utility of data collected from these monitoring locations to answer management questions. The number and location of trash booms that will be included in the Monitoring Program are described in Section 3.4.2.

Focusing on monitoring trash that is deposited in flowing water bodies and shorelines during this permit term is the most responsible approach to take over the next 2+ years because parallel efforts (e.g., OPC's evaluation and testing of trash monitoring methods) are also currently underway, which will assist BASMAA in determining the efficacy of implementing trash monitoring methods that focus on monitoring other water body types and components than those that are the focus of the BASMAA Monitoring Program Plan. Based on the lessons learned over the next 2+ years through BASMAA's and parallel efforts focused on testing monitoring methods, BASMAA plans to recommend trash monitoring methods and approaches that should be considered for implementation during MRP 3.0. These recommendations will include lessons learned through BASMAA, OPC and RMP efforts to identify the most practical and repeatable methods for monitoring trash in different components of receiving water bodies. These

recommendations will be included in the Final Monitoring Report developed through the BASMAA Trash Monitoring Program and submitted to the Water Board by July 1, 2020.

3.2. SCIENTIFIC MONITORING QUESTIONS

Once the types of receiving water bodies and components/habitats were selected, scientific monitoring questions were developed to further assist with the study design and selection of methodologies that will be used during the testing phase of the Trash Monitoring Program to begin answering the broader Management Questions presented in Table 2-3. The scientific monitoring questions developed and the associated Management Questions are described in **Table 3-2**. The study design described in Section 3.3 and the data analysis techniques discussed in Section 6.2 are intended to answer these scientific monitoring questions.

Table 3-2. Scientific monitoring questions developed to assist with the study design of the testing (Phase I) of the Trash Monitoring Program Plan.

Management Question	Scientific Monitoring Question
1. Is trash present in receiving water(s) at levels that may cause adverse water quality impacts?	• What is the current level of trash deposited in flowing waterbodies in each MRP county; the entire MRP area? • Are significantly strong correlations observed between qualitative and quantitative methods? • What is the range of trash levels observed at sites targeted for cleanup? How do these ranges compare to levels in all flowing waterbodies?
2. Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s) (*over time*)?	• What is the current level of trash deposited in flowing waterbodies in each MRP county; the entire MRP area? • Are significantly strong correlations observed between qualitative and quantitative methods? • Do trash levels in flowing waterbodies strongly correlate to trash generation levels depicted on Permittee maps?
3. Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?	• What is the current level of trash deposited in flowing waterbodies in each MRP county; the entire MRP area? • Are significantly strong correlations observed between qualitative and quantitative methods? • What is the range of trash levels observed at sites targeted for cleanup? How do these ranges compare to levels in all flowing waterbodies?
4. Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?	• What percentages of trash observed in receiving waters are attributable to stormwater conveyance systems, direct dumping, wind, and encampments.
5. Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	• What is the estimated amount of trash transported annually to the Bay from monitored creeks, rivers and channels? • Do trash levels in flowing waterbodies differ significantly between wet and dry seasons?

3.3. SUMMARY OF STUDY DESIGN AND METHODOLOGIES

The design of the Trash Monitoring Program Plan and monitoring methods developed for testing are intended to begin addressing the receiving water trash monitoring questions included in MRP 2.0. To this end, the Trash Monitoring Plan utilizes an existing probabilistic (random) monitoring design that was recently established via BASMAA's Regional Monitoring Coalition (RMC) Creek Status Monitoring Program (EOA, Inc. & Armand Ruby Consulting, 2012), and monitoring at targeted sites in lotic waterbodies and along shorelines where trash regularly deposits and is periodically removed by Permittees and volunteers. Together, probabilistic and targeted sites are intended to represent the full range of trash levels and conditions present in all creeks, rivers and channels flowing through urban areas subject to MRP 2.0 trash reduction requirements and Bay shorelines that may be impacted by MS4 contributions of trash.

Targeted and probabilistic monitoring sites represent a wide range of watershed drainage area characteristics that may affect trash loading and transport in receiving waters. The results of preliminary analyses of watershed characteristics associated with the vast majority of probabilistic sites are provided in **Attachment 5**. Although watershed characteristics for all probabilistic and targeted sites have not yet been analyzed, they will be identified and evaluated *a posteriori*, during the data analysis and interpretation stages, to assist Permittees in understanding the primary drivers for trash levels observed in creeks, channels, rivers and Bay shorelines. Additional details on the design of the Trash Monitoring Program Plan are included in Section 3.3.

Trash monitoring methodologies developed for testing during Phase I of the Trash Monitoring Program are based on a review of existing methods used by scientists, non-governmental organizations, volunteers and regulators to monitoring trash in receiving waters (see **Attachment 2**). Trash monitoring methodologies that will be used by MRP Permittees can generally be divided into two categories: (1) qualitative visual assessments; and (2) quantitative monitoring. For qualitative visual assessments, trained observers will assign a score to a site based on the levels of trash observed. Qualitative monitoring will occur at probabilistic and targeted monitoring sites located on creeks, channels, rivers, shorelines, beaches and urban lagoons/lakes. For quantitative monitoring, trained personnel will collect and determine the volume of trash collected at targeted monitoring sites. Contributions from observable pathways and sources will also be documented at sites where qualitative visual assessments and quantitative monitoring will occur. Additional details on the monitoring design is described later in this section, and monitoring methods and protocols are described in Section 4.0. A matrix comparing the two types of monitoring/assessments methods to management questions included in MRP 2.0 is presented in **Table 3-3**.

Table 3-3. Comparison between MRP 2.0 Receiving Water Trash Management Questions and monitoring/assessment methods that will be tested during Phase I of the Monitoring Program.

Refined Receiving Water Monitoring Questions[8]	Methodologies	
	Qualitative Visual Assessments	Quantitative Monitoring
1. Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts?	✓	✓
2. Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s) (*over time*)?	✓	✓
3. Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?	✓	✓
4. Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?	✓	✓
5. Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?		✓

3.4 MONITORING SITE LOCATIONS

3.4.1 Probabilistic (Ambient) Sites

Regionally, a total of 125 urban creek, channel and riverine sites will be randomly selected (i.e., probabilistic) from a pool of 339 sites previously sampled for other water quality parameters by Permittees. Because they were selected through a statistically-based design, this group of sites is representative of the range of lotic (flowing) waterbodies that flow through urbanized areas within the MRP 2.0 boundaries.

The probabilistic monitoring sites were derived from the statistically-based sampling frame established through the Bay Area's RMC Regional Creek Status and Trends Monitoring Program. Status and trends monitoring is currently conducted by Permittees in flowing waterbodies interspersed among 3,407 square miles of land in the San Francisco Bay Area. The water bodies monitored by the RMC include all perennial and non-perennial creeks and rivers that run through urban and non-urban areas within the portions of the five participating counties that fall within the SFBRWQCB boundary, and the eastern portion of Contra Costa County that drains to the Central Valley region. Probabilistic sites were selected from a random sample draw of sites on receiving waters included in the USGS National Hydrography Dataset, which covers 5,740 km of stream length. Sites were selected at an average density of one site per kilometer of stream length. The RMC probabilistic design serves to establish current (baseline) ecological conditions in receiving waters via bioassessment, physical habitat assessments, and measurements of various water quality parameters. Details of the RMC framework are summarized in the *BASMAA Regional Monitoring Coalition Creek Status and Long-Term Trends*

[8] The four questions posed in MRP 2.0 were split into the following five questions to design the Monitoring Program Plan.

Monitoring Plan (EOA, Inc. & Armand Ruby Consulting, 2012). Five years of RMC sample data have been collected to-date by Permittees at 280 wadeable creek/channel monitoring sites.

The probabilistic portion of this Trash Monitoring Program Plan will primarily focus on assessing trash levels and pathways at RMC probabilistic sites that drain urban land areas and have been previously monitored via the Creek Status and Trends Monitoring Program. Because they were previously sampled by Permittees, these urban[9] sites generally represent accessible locations where trash monitoring can occur most easily. Because non-wadeable and tidally influenced sites that may be of interest for trash were originally removed from the site pool by the RMC due to bioassessment protocol limitations, these sites were added back into the site pool for trash monitoring and placed into the list in their original order in the probabilistic draw. **Table 3-4** lists the number of available probabilistic sites and the number sites that will be assessed within each applicable county. **Figures 3-1** through **Figure 3-5** illustrate the locations of sites within the RMC pool for each county. The entire site list for each county is included as **Attachment 6**.

Table 3-4. Number of probabilistic creek, channel and riverine sites by county that will be assessed for trash levels and sources/pathways during Phase I of the Trash Monitoring Program.

County	Available # of Sites in RMC Pool	Target # of Randomly Selected Sites for Trash Assessments
Alameda	109	30
Contra Costa	64	30
San Mateo	47	30
Santa Clara	107	30
Solano (Vallejo, Suisun City and Fairfield)	12	5
Totals	**339**	**125**

3.4.2 Targeted Sites

In addition to the trash assessments conducted at probabilistic sites, Permittees will qualitatively assess and quantitatively monitor trash at a total of 100 targeted sites located in urban creeks, channels, rivers, lagoons, and Bay/ocean shorelines. Targeted sites will be located at locations where trash is known to accumulate and are targeted for cleanup events (e.g., trash hot spots) or other equivalent locations that are known to have relatively high levels of trash accumulation. Targeted sites are intended to represent receiving water locations that are trash accumulation areas within the MRP 2.0 boundaries. That said, trash accumulates at hot spots at varying levels,

[9] Probabilistic sites classified as urban are located within the boundaries of a city or a populated place.

and therefore monitoring targeted sites will allow the testing of trash monitoring protocols under a wide range of trash conditions.

Trash Hot Spots

Provision C.10.c. of MRP 2.0 requires Permittees to clean 193 Trash Hot Spots to a level of "no visual impact" at least once per year for the term of the permit. Trash Hot Spots are sections of creek or shoreline impacted by trash that are at least 100 yards (300 feet) of creek length or 200 yards (600 feet) of shoreline length locations. Permittees are required to maintain the same number of Trash Hot Spots identified in the previous permit (i.e., MRP 1.0), or select new Trash Hot Spot locations if past locations are no longer Trash Hot Spots or if other locations may better align with trash management areas. The number of Trash Hot Spots for the previous permit term were selected based on population or acreage of commercial land area: 1) One per 30,000 people, or 2) one per 100 acres of commercial land area, whichever is greater. In addition to amount of visible trash, the location(s) of Trash Hot Spots may also have been selected based on accessibility, safety, and proximity to other Trash Hot Spots or downstream of trash depositional areas.

Permittees currently quantify and report the volume and dominant types of trash removed from each Trash Hot Spot cleanup and attempt to identify sources and pathways to the extent feasible. Permittees also perform photo documentation of the site before and after the cleanup activity, with a minimum of one photo per 100 feet of Hot Spot length. Permittees report the volume removed for the most recent five years of Hot Spot cleanups in each Annual Report, or if a new Trash Hot Spot location is selected, Permittees report the volume removed for the years of cleanup of that Trash Hot Spot. The quantitative monitoring protocol summarized in Section 4.3 and included as **Attachment 7** incorporates and builds upon existing assessments conducted by Permittees in compliance with Provision C.10.c.

Table 3-5 provides a summary of the number of Trash Hot Spots that are cleaned annually and the total number of targeted sites in each county that will be monitored during Phase 1 of the Trash Monitoring Program. **Figures 3-1 through 3-6** illustrate the locations of Trash Hot Spots previously cleaned in each county, consistent with MRP 2.0. During Phase I of the Monitoring Program, a portion of the sites that are cleaned in compliance with Provision C.10.c, will serve as targeted monitoring sites. This subset of Trash Hot Spots will be selected by Permittees to represent a wide range of trash conditions/levels to allow protocols described in Section 4 to be tested. To the extent possible, the subset selection process should also attempt to achieve the goal of including at least one trash hot spot per Permittee into the list of sites that will be monitored as part of this Plan.

Table 3-5. Number of targeted monitoring sites in creeks, channels, rivers, lagoons and Bay shorelines by county that will be assessed and monitored during Phase I of the Trash Monitoring Program.

County	# Trash Hot Spots Cleaned Annually	# of Targeted Trash Monitoring Sites*
Alameda	55	29
Contra Costa	37	19
San Mateo	29	15
Santa Clara	62	32
Solano (Vallejo, Suisun City and Fairfield)	10	5
Totals	**193**	**100**

*Does not include trash booms sites described below.

Trash Booms

Some Permittees have installed booms or barriers to control, contain, deflect or exclude floating trash and debris from entering downstream waterbodies. The locations of trash booms are shown in **Figures 3-1 through 3-6**.

In addition to the targeted monitoring sites described above, Permittees will conduct quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons. The goal of the quantitative monitoring at booms is to better understand the utility of data collected from these monitoring locations in answering management questions outlined in the MRP. In particular, question #5 - *Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?*

A minimum of one quantitative trash monitoring event will be conducted at selected trash boom locations. The following trash booms will be considered for quantitative monitoring:

- Three booms in Marina Lagoon, 16th Avenue Channel and 19th Avenue Channel (City of San Mateo);
- Five booms in Lake Merritt (City of Oakland);
- One boom in Matadero Creek and one in Adobe Creek (City of Palo Alto and SCVWD); and
- One boom in Thompson Creek and one in Lower Silver Creek (SCVWD).

The quantitative monitoring protocol described in **Attachment 7** will be used during each of the boom monitoring events. The timing of monitoring events will coincide with boom maintenance

and cleaning schedules, which generally occur prior to and following storm events and the wet weather season (as applicable).

3.5 TIMING AND FREQUENCY

Trash monitoring and assessment data will be collected during both wet and dry seasons during the testing phase. Data collected during both seasons will allow for seasonal comparison between dry and wet season trash conditions and accumulation rates in receiving waters. Dry season monitoring will provide information about non-stormwater sources and pathways, such as wind and illegal dumping. Wet season monitoring will provide information on the transport and deposition of trash resulting from stormwater runoff. Wet season monitoring will focus on trash that accumulates after storms that generate at least 0.5 inches of precipitation. Wet season monitoring will not, however, be conducted after extremely large storms due to the risk that these storms will likely transport the majority of trash downstream and therefore sample locations may appear cleaner compared to typical storm conditions.

The conceptual model on the sources, transport pathways, and factors that contribute to the accumulation of trash in receiving waters that was previously developed by Permittees, conclusions drawn from the SWAMP Rapid Trash Assessment Program (SFBRWQCB 2017), and Permittee experience in removing trash from hot spot locations helped to inform the proposed monitoring frequency included in this Trash Monitoring Program Plan. The monitoring frequencies agreed upon by Permittees were designed to begin addressing questions regarding the temporal variability in trash levels at monitoring sites. Specifically, monitoring frequencies are intended to evaluate to what degree trash levels vary at sites between dry seasons, wet seasons, and dry and wet seasons.

The frequencies that monitoring and assessment will occur at probabilistic and targeted sites during the testing phase of this Monitoring Plan are included in **Table 3-6**. In summary, monitoring/assessment will occur at the following frequencies:

- All 125 probabilistic sites will be qualitatively assessed during two dry seasons (2018 and 2019) and three wet seasons (2017-18, 2018-19, and 2019-20); and
- All 100 targeted sites will be qualitatively assessed and quantitatively monitored during two dry seasons (2018 and 2019).

This monitoring will result in Permittees collectively conducting 825 qualitative assessments and 200 quantitative monitoring events over the course of the testing phase (**Table 3-7**).

Table 3-6. Summary of the planned timing and frequency of monitoring events at each probabilistic and targeted site during Phase I of the Trash Monitoring Program.

Season	Method and Frequency of Monitoring/Assessment	
	# Qualitative Assessments at each Probabilistic Site (n=125 sites)	# Qualitative Assessments AND Quantitative Monitoring Events at each Targeted Site (n=100 sites)[b]
2017-18 Wet Season (October – March)	1	-
2018 Dry Season (April – September)	1	1
2018-19 Wet Season (October – March)	1	-
2019 Dry Season (April – September)	1	1
2019-20 Wet Season [a] (October – February)	1	-
Totals	**5**	**2**

[a] It is assumed that monitoring will stop by February 2020 in order conduct data analysis and interpretation, and prepare the Final Report due July 1, 2020.

[b] Numbers do not include trash booms where quantitative monitoring will occur.

Table 3-7. Planned number of qualitative assessment and quantitative monitoring events conducted in each county during Phase I of the Trash Monitoring Program.

County	# Monitoring/Assessment Events	
	Qualitative Assessments	**Quantitative Monitoring[a]**
Alameda	208	58
Contra Costa	188	38
San Mateo	180	30
Santa Clara	214	64
Solano (Vallejo, Suisun City and Fairfield)	35	10
Totals	**825**	**200**

[a] Numbers do not include quantitative monitoring events that are planned to occur at trash booms.

4 Trash Monitoring and Assessment Protocols

4.1 OBJECTIVES FOR THE TESTING PHASE

The monitoring protocols summarized in this section and included in **Attachment 7** were developed to address the following objectives established for the Monitoring Program Plan's testing phase:

- Establish current (baseline) ambient trash levels/conditions in receiving waters (focusing on creeks, channels, lagoons and the Bay shoreline), which will assist with future trends strategy development and implementation;
- Test methods designed to identify and estimate contributions from different pathways of trash to receiving waters;
- Evaluate additional data to be collected to facilitate a comparison of site characteristics after data are collected (*a posteriori* data analysis*)*;
- To the extent feasible, use simple approaches and protocols; and
- Include protocols that could be implemented by volunteers.

As illustrated in **Attachment 2**, trash monitoring programs have previously utilized methodologies that are either: 1) **Quantitative** – resulting in measurements of the weight, volumes or pieces of trash; or 2) **Qualitative** – resulting in a general estimate of trash levels or types. This Monitoring Program Plan utilizes both types of methodologies to achieve the monitoring goals and objectives.[10] Each method was selected to assist Permittees in beginning to address the trash monitoring questions posed in MRP 2.0. This section summarizes the procedures that will be used to:

- Select qualitative assessment sites from the RMC's probabilistic site pool;
- Define the area within each site where trash monitoring or assessments will be conducted;
- Conduct Permittee-led qualitative visual assessments and quantitative monitoring; and
- Collaborate with volunteer monitoring efforts.

Standard Operating Procedures (SOPs) and field forms for conducting qualitative visual trash assessments and quantitative trash monitoring are included as **Attachment 7**. These SOPs were developed during the development of this Monitoring Plan and are based on the recommendations that resulted from the evaluation of existing protocols and tools (see **Attachment 2**).

[10] Methods and protocols designed to characterize the types of trash items collected were not included in the testing phase of this Monitoring Program Plan because no direct linkage between trash characterization and the MRP trash management questions could be established. Should Permittees choose to characterize trash collected via this Plan, we recommend that clearly defined objectives be established prior to developing the list of trash categories and protocols previously used by Bay Area Permittees be reviewed to allow for consistency among projects to the extent possible (BASMAA, 2015; ACCWP & ACWMA, 2014; SCVURPPP 2016).

4.2 SELECTING SITES FROM THE PROBABILISTIC SITE POOL

A total of 339 probabilistic RMC receiving water sites are available to Permittees for conducting qualitative visual trash assessments. To select the sites that will be assessed as part of this Monitoring Program Plan, a representative for each MRP applicable county will use the following procedure, which is generally consistent with the *Standard Operating Procedures for Ambient Creek Status Monitoring Site Evaluation* (BASMAA 2016):

1. Attempt to Gain Access to the Required Number of Sites
   Starting with the first site on the list included in **Attachment 6**, attempt to gain access to the required number of probabilistic sites for your county (see **Table 3-2**). Attempt to obtain permission to access site from property owner by sending permission packets to the owners of ALL privately owned sites and any agency or company requesting a letter or information about sampling activities. For site under public ownership, the proper agency and personnel must be contacted to determine if a permit, entry agreement or permission letter is needed. A complete effort needs to be made to determine who and what agency manages the water body where the site is located. Contact all possible agencies and land managers to inform them of planned monitoring activities.

   Access permission to sample can be denied in the following ways:

   - The permission letter is returned denying access to the site; or
   - Permission is denied over the phone or via email, or
   - There is no response from the owners after two attempts to contact them, or
   - The letter is returned with no response and a second attempt to contact them does not change this result, or
   - The letter is returned unopened and a second attempt to contact them either does not result in permission to access site or contact is not possible.

   Permission to sample can be granted in the following ways:

   - The permission letter has been returned, granting access to the site, or
   - A required permit has been submitted and approved by the agency that manages the water body at the location of the site, or
   - Permission has been granted over the phone or via email.

   Note: It is very important for the integrity of the probabilistic design for each Permittee to begin at the top of the site list included in **Attachment 6**, and systematically work their way down through the list in the order provided. Those Permittees attempting to gain access to the required number of sites should avoid, at all costs, skipping sites on the list where access may be granted. Additionally, Permittees should clearly document all sites where access was denied and replace the site with the next available site on their list.

2. Conduct Field Reconnaissance
   In most cases, a site visit is necessary to confirm that the site is accessible and safe for conducting visual trash assessments. Property owners or local resource managers associated with a site should be contacted prior to the site visit. If a site is inaccessible or

unsafe, then the Permittee should document this finding and move onto conducting reconnaissance at the next site on the site list where access was obtained.

3. Document Final Site List
   Once access permission and safety considerations have been addressed, Permittees should document the location of the full set of probabilistic monitoring sites that have been selected. Documentation should include identification on maps and the list included in **Attachment 6**.

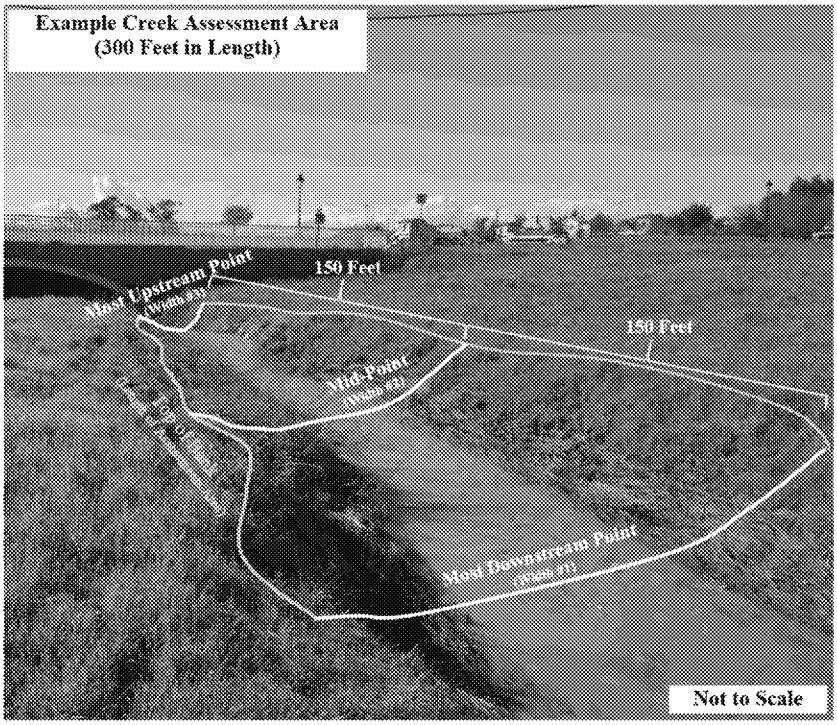
4.3 DEFINING TRASH MONITORING/ASSESSMENT AREAS

As described in Section 3, trash monitoring and assessment sites were derived from the RMC's Creek Status and Trends Monitoring Program (BASMAA, 2010) and also include a subset of the MRP-required Trash Hot Spots. This section summarizes the process that Permittees will use to delineate the area where qualitative visual assessments and/or removal of trash for quantitative monitoring and characterization will be conducted. Because the assessment area differs by receiving water type, assessment area delineation procedures for creeks, channels and the Bay shoreline are discussed separately below. Figures showing how to delineate an assessment area for creeks/channels/rivers, and the Bay shoreline locations are included in **Attachment 7.**

4.3.1 Creeks/Channels/Rivers

The minimum length of the assessment area for assessment/monitoring sites on creeks, channel and rivers is 300 feet, which is generally consistent with the length used by the RMC Creek Status and Trends Monitoring Program and for Trash Hot Spots. Assessment areas with longer lengths will be documented by field crews. Field reconnaissance will be conducted at each monitoring site to measure and document the assessment length, including recording GPS coordinates at the most downstream location, using easily identified landmarks to the extent possible at upstream and downstream ends of the reach. The widths will be measured and documented, and photos will be taken at three locations (i.e., furthest downstream, roughly the midpoint, and the furthest upstream) in the trash assessment area. In addition, the assessment reach will be divided into 100-foot segments that will be distinguished using easily removable markers (e.g., surveyor's flags). Photo documentation will be conducted at each 100-foot segment, standing as near to the middle of the channel as possible, looking upstream. Segments should be labeled numerically (i.e., 1-3) beginning at the furthest downstream segment.

To the extent possible, the assessment area width for sites on creeks, channels and rivers will extend to the top of bank. "Top of bank" refers to the creek or channel boundary where a majority of normal discharges and channel-forming activities takes place. The top of bank boundary will contain the active stream channel, active floodplain, and its associated banks. For sites where the top of bank is not accessible or safe for field crews to access, the width of the assessment area will be documented as the average distance from the center of the creek or channel on each bank. An example image illustrating a delineated assessment area on a creek is included below.



4.3.2 Shorelines

A minimum length of the assessment area for monitoring sites located on the Bay or Pacific Ocean shoreline or beach is 600 feet, which is consistent with the minimum length for a Trash Hot Spot as described in MRP Provision C.10.c.i. For Bay/Ocean shoreline monitoring locations, the shoreline assessment area width is delineated as appropriate, based on a change in substrate material, presence of a line of upland vegetation, or onset of development. Similar approach for measuring assessment widths and photo documentation described in previous section should be conducted. An example image illustrating a delineated assessment area on a shoreline is included below.

4.4 QUALITATIVE TRASH ASSESSMENTS

Based on the review of existing monitoring protocols and the goals and objectives of this Trash Monitoring Program Plan, qualitative visual trash assessments are the ideal methodology for Permittees and volunteers to use when attempting to assess the general levels of trash observed in creeks, channels, rivers, lagoons and shorelines. Qualitative assessments are also consistent with the spirit of the MRP receiving water trash monitoring requirements, and are appropriate given the relatively high levels of trash currently present in receiving waters. That said, qualitative methods have an inherent level of subjectivity that must be contained via quality assurance and control measures, as described in Section 5. Additionally, qualitative assessment scores should ideally be linked to quantitative measurements of trash to allow comparison to quantitative or qualitative data generated via other types of existing or future trash monitoring programs (e.g., on-land visual assessments or in-Bay water column monitoring). By pairing qualitative assessments with quantitative monitoring, comparisons between the two methods will be made with data collected via this Trash Monitoring Plan. If successful, the use of qualitative assessments as surrogates for quantification will allow Permittees, the Regional Water Board and stakeholders (including volunteers) to assess trash conditions more frequently and at a far greater number of sites, compared to the resources necessary to quantitatively monitor trash in receiving waters.

Qualitative visual assessment methods that are largely based on the *Rapid Trash Assessment (RTA)* protocol (SFBRWQCB, 2007) and the *City of San Jose's Trash Receiving Waters Monitoring Plan* (San Jose 2016) will be employed at all probabilistic and targeted monitoring sites described in Section 3. The Standard Operating Procedure (SOP) for the qualitative assessment method is included as **Attachment 7**. The qualitative assessment method entails a visual survey that documents the levels of trash observed within creeks, channels, rivers, lagoons, and shorelines; and estimates the relative contribution[11] of trash observed at a site that is attributable to different transport pathways (i.e., stormwater/wind, illegal encampments, direct dumping). Crew members will walk the entire assessment area and based on their observations, assign an assessment score using condition category descriptions provided in the SOP. The field crew will also estimate the types of trash transport pathways and the relative proportion of trash that each pathway has contributed to the assessment area. To evaluate the effects of vegetation on trash accumulation, the qualitative assessment SOP also includes the documentation of the extent and type of vegetation/vegetative debris observed in the assessment area. The number and size of stormwater outfalls observed in the assessment area will also be recorded.

4.5 QUANTITATIVE TRASH MONITORING

Quantitative monitoring methods will also be used during the implementation of this Trash Monitoring Program Plan. The quantitative monitoring SOP included in **Attachment 7** will be implemented at all targeted monitoring sites described in Section 3, including selected trash booms. The protocol for quantitative monitoring will include the measurement of the volume of trash collected from within defined assessment areas in creeks, channels, rivers, lagoons and Bay shorelines. During collection, trash will be segregated (to the extent possible) into different transport pathways based on four characteristics of the trash present: type, size, condition, and location within the assessment area.

To measure the volume of trash from each pathway, trash that is collected will be placed (un-compacted) temporarily into buckets or bags of known sizes and recorded on field datasheets. Materials that are too large to be placed in buckets or bags (e.g., construction materials or appliances) will be stacked together (by pathway) and the volume will be estimated visually. Measurements of trash in buckets or bags will be recorded in gallons, in 0.5 gallon increments. Volume estimates for large items will be recorded in cubic feet (or cubic yards. Field data forms are included in **Attachment 7**. Please note that due to existing policies, trash associated with the illegal encampment pathway may not be able to be removed from the site at the time the quantitative monitoring event occurs. In these instances, the volume of trash will be estimated during the event and removal will need occur at a later time consistent with posting requirements.

The top five items observed (by number) by field crew members during the quantitative event will also be recorded on field data forms. Additionally, photo documentation of trash conditions will occur before and after each quantitative monitoring event using procedures described in

[11] Estimating the relative contribution of trash from specific pathways is very challenging and based on the review of existing trash monitoring efforts (see Attachment 2) has not been attempted in the past. Therefore, this aspect of the protocol is truly exploratory and the results should be considered provisional.

Attachment 7. Additional photos illustrating the gross amount of trash removed from the site (i.e., bags and large material) will also be taken by field crews.

4.6 VOLUNTEER MONITORING

The qualitative assessment and quantitative monitoring protocols summarized in Section 4.3 and 4.4 and included in **Attachment** 7 are suitable for trash monitoring efforts conducted by volunteers. By using these protocols, along with training and the implementation of acceptable quality assurance/control procedures, volunteers can reliably collect data comparable to MRP Permittees. MRP Permittees intend to make available training opportunities for local volunteer groups and other departments and/or agencies that may conduct cleanups along creeks, channels and Bay shorelines during the testing period. This training will be completed to ensure that all entities collecting data understand how to correctly implement the qualitative and quantitative protocols, and the minimum data standards that must be achieved in order for Permittees to consider integrating volunteer data into Receiving Water Trash Monitoring Program data management systems. Should trash monitoring data be collected by volunteers or other agency staff that are trained in the use of the SOP included in Attachment 7, MRP Permittees will evaluate the data using quality assurance/control procedures described in Section 5 and based on the results of this evaluation, consider incorporating such data into data management systems and interpretive reports.

5. Quality Control and Assurance

5.1 QUALITY ASSURANCE ROLES AND RESPONSIBILITIES

BASMAA member agencies include Stormwater Programs that are generally organized by County. This Plan assumes that trash monitoring/assessment described in this Plan will be managed and conducted individually by each Stormwater Program, in coordination with other BASMAA member agencies. This includes quality assurance and control (QA/QC) procedures described in this section.

There are three main roles that will be filled by each Stormwater Program to ensure the effective implementation of the program and QA/QC procedures. Each role and responsibility is described below.

- **Monitoring Project Manager** – Main responsibility will be to oversee and coordinate all aspects of the receiving water trash monitoring program for his/her Stormwater Program. Responsibilities will include conducting/coordinating the appropriate training of the Field Crew Supervisor(s) and Field Crew Members; selecting probabilistic and targeted sites; coordinating the management of all data collected during monitoring/assessment events; overseeing and conducting all QA/QC procedures; and overseeing the interpretation and reporting of the data.
- **Field Crew Supervisor(s)** – One or more individuals for each Stormwater Program that will oversee field assessment and/or monitoring activities at specific sites or events, and Field Crew Members assisting with monitoring/assessments. The Supervisor should be trained in the protocol and use of the data collection form; present at all applicable assessment/monitoring events; lead the recording of information on the data collection forms, including condition assessments, vegetative cover/structure assessments, volume measurements, photo documentation and pathway analysis; and participating in QA/QC procedures in the field.
- **Field Crew Members** – One or more individuals for each Stormwater Program that assists the Field Crew Supervisor in conducting qualitative assessments and quantitative monitoring. Field Crew Members are not required to go through formal training, but should have read the protocol and understand the field safety procedures.

5.2 PERMITTEE TRASH MONITORING PROGRAM

Data Quality Objectives (DQOs) have been established for the Monitoring Program Plan to ensure that data collected are sufficient and of adequate quality for the intended use. DQOs include both quantitative and qualitative assessment of the acceptability of data. The qualitative goals include representativeness and comparability, and the quantitative goals include completeness and precision. Measurement Quality Objectives (MQOs) are the acceptance thresholds or goals for the data.

Approaches used for data quality assurance for assessments and characterizations of trash do not have the same application as more commonly-used chemical analyses. Instead of using the repeatable physical and chemical properties of target constituents to assess accuracy and precision, information and data collected on trash are quantified using personnel trained in the

characterization and classification of data. Compounding the challenge between chemistry and quantification of trash is the inherent spatial and temporal variability in trash loading and transport. Unlike chemical data where replicate sampling and analysis of samples are expected to be similar, no such expectation exists for trash data. Hence, DQOs have a strong emphasis on training and oversight, with intercomparisons between performance of individual field team members participating in the various assessment and characterization efforts. In addition, chemical approaches that focus on accuracy do not apply to trash monitoring. For example, matrix spikes used for chemistry have no parallel for trash samples. Thus, a new approach using intercalibration amongst personnel conducting assessments/characterizations was the primary mechanism for assuring accuracy and precision.

The following DQOs and MQOs are established for this project and will be:

1. The representativeness of data is the ability of the sampling locations and the sampling procedures to adequately represent the true condition of the sample sites. Representativeness of the sampling event is ensured by sampling within the established assessment area and specified timeframe. The MQOs for sampling event representativeness are measured by proximity to the site location. The corrective action for this MQO for the Field Crew Supervisor to flag samples that are collected outside of the defined assessment area or sampling timeline/frequency.
2. Comparability is the degree to which data can be compared directly to other relevant studies. The MQOs will rely on training and oversight of the Monitoring Program Manager, Field Crew Supervisor, and Field Crew Members to follow field sampling protocols to ensure comparability with other studies that utilize similar protocols.
3. Completeness is defined as the percentage of valid data collected and analyzed compared to the total expected to being obtained under normal operating conditions. For qualitative visual assessments, the objective is to conduct one assessment in each 300-foot segment in the assessment area for each site. An overall completeness of greater than 90% of the assessment area segments is considered acceptable for the Receiving Water Trash Monitoring Program. The Field Crew Supervisor should check both qualitative and quantitative data collection forms to make sure they are complete and accurately filled out, prior to leaving the site. Additionally, following quantitative monitoring events, Field Crew Supervisor should also check the site to make sure that the vast majority of the trash present was removed from the assessment area. Photographs of the site after the cleanup has occurred should also be taken.
4. Precision is used to measure the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions. Overall precision usually refers to the degree of agreement for the entire sampling, operational, and analysis system.

   For qualitative visual assessments, precision will be evaluated at 10% of the assessment events conducted by a Stormwater Program. The events should be randomly picked by the Monitoring Program Manager. Precision will be measured by comparing the assessment data collected by the Field Crew Supervisor overseeing the event and the data

collected (in parallel) during the event by the Monitoring Program Manager or second Field Crew Supervisor.

For quantitative monitoring events, precision will also be evaluated at 10% of quantitative events conducted by each Stormwater Program. The events should be randomly picked by the Monitoring Program Manager. Monitoring data collected by the Field Crew Supervisor overseeing the quantitative event and the data collected (in parallel) during the event by the Monitoring Program Manager or second Field Crew Supervisor will be compared.

A target relative percent difference between qualitative data points or quantitative measurements (measured in parallel by separate individuals) is < 20%.

Additionally, the accuracy in the reporting of crew members and Field Crew Supervisors on field data sheets is very important. All individuals present at the site and participating in the qualitative assessment of qualitative monitoring events should be recorded.

5.3 VOLUNTEER MONITORING

The QA/QC program for volunteers will consist of training volunteers on how to conduct trash assessments/monitoring using the SOPs in Attachment 7, and complete the necessary documentation. Prior to conducting trainings and volunteer-led assessments/monitoring, considerations should be given to the coordination volunteers, safety, permitting, insurance and decontamination. All volunteers that plan to conduct trash monitoring/assessments should complete the training with a good understanding of how the volunteer data collection efforts tie into the more comprehensive receiving water trash monitoring efforts conducted by MRP Permittees, and the intended use of the data. While in the field, volunteers will work in teams of at least two persons to help ensure agreement of the qualitative and quantitative results. A Field Crew Supervisor should also be present to review the volunteer monitoring data collection forms for completeness and flag any suspect results based on factors such as, but not limited to, inconsistency with previous monitoring data or obvious transcription errors.

The Monitoring Project Manager and/or Field Crew Supervisor will also attempt to provide feedback to volunteers on data collection efforts and results and interpretations of the data collected. Draft interpretive reports will be provided to volunteers for comment, prior to submittal to the Regional Water Board.

6. Data Management, Analysis and Interpretation

6.1 DATA MANAGEMENT AND ACCESSIBILITY

As part of the development of this Monitoring Program Plan, existing and potential systems and protocols that could be employed to meet the Program's data management goals and the trash receiving water monitoring requirements of the MRP were evaluated. Per the MRP, the Monitoring Program Plan must include a system to manage and access monitoring results. The process for development of this system consisted of a review of existing and potential data management approaches, strategies, and protocols; a survey of stakeholders and trash monitoring personnel to solicit input and insight on current data management systems; and engagement of the PMT members and stakeholders.

The review prioritized data management systems through the consideration and weighting of various data management goals including, but not necessarily limited to:

- Spatial visualization;
- QA/QC considerations;
- Cost effectiveness;
- Accessibility by Permittee and Stormwater Program staff;
- Tools already in use by Permittees; and
- Management requirements such as providing Permittees, regulators, and the public with accessible reports.

The evaluation of data management strategies resulted in recommendations related to the suitability of existing and need for new, data management tools. In summary, the recommended data management strategy is to build upon the California Environmental Data Exchange Network (CEDEN) (http://ceden.org/index.shtml), which is the State of California's existing data management framework for water quality data in receiving waters. CEDEN also provides Permittees, the Regional Water Board, and other stakeholders access to the data, and provides the ability to integrate data collected by volunteers that meet data quality standards into a data management system that also houses data collected by MRP Permittees. A description of CEDEN, the modifications that will need to occur to accept trash data collected using SOPs described in Attachment 7, and the consideration of "provisional data" collected as part of the initial phase of the Monitoring Program Plan are discussed below.

6.1.1 California Environmental Data Exchange Network

CEDEN is the preferred data management system to store data collected via the Trash Monitoring Program Plan. CEDEN is a web-based portal that provides a central location to find and share information about California's water bodies. CEDEN is managed and funded by the State of California and contains water quality data from Bay Area receiving waters. CEDEN aggregates many different types of monitoring data and makes them accessible to environmental managers and the public. CEDEN can accept many different types of monitoring data and has provided templates and QA/QC guidelines for the submission of this data, including the submission of data collected by volunteers.

To some extent, CEDEN is currently set up to manage trash data. Data consistent with the SWAMP Rapid Trash Assessment (RTA) protocol is currently accepted by CEDEN. Since the protocols being utilized in this Monitoring Program Plan are somewhat similar to the RTA, minor modifications of CEDEN will be needed to accept all data collected. Over the course of the testing phase of this Monitoring Program Plan, Permittees will work with the SF Bay Area Regional Data Center (i.e., San Francisco Estuary Institute) to ensure that CEDEN will accept and accommodate trash monitoring data generated in the Bay Area. Modifications to data table formats, fields, naming conventions and units will likely be needed. While CEDEN updates are taking place, Permittees should ensure that field data sheets are stored in duplicate at separate locations, and electronic data are stored and backed up onto separate networks to avoid the loss of data/information.

Data generated during the initial phase will be considered provisional since the protocols being used are experimental. Data entered into CEDEN should be appropriately flagged as "provisional" until the protocols can be further tested and standardized, in collaboration with Regional and State Water Board staff and other applicable scientific organizations (e.g., OPC, SCCWRP, and SFEI).

6.1.2 Data Management QA/QC Considerations

In addition to QA/QC procedures described in the previous section, data management requires the consideration of certain QA/QC methods to ensure that the quality of the data collection can be maintained before data collection, during data entry, and following data entry. The USGS provides several suggested standards and considerations for QA/QC for data management (USGS, 2017), summarized below:

Quality Assurance before Data Collection

- Define standards and cross train field staff prior to collection of the data:
    - Determine format of data collection (e.g., paper or digital);
    - Define the meaning of codes, acronyms, and other shorthand;
    - Specify units of measurement; and
    - Create metadata in unison with the data to be collected.
- Assign QA/QC to a designated person

Quality Assurance/Quality Control during Data Entry

- Check data-entry:
    - Have second person check the data entered
- Design an efficient storage system for the data
    - Minimize the number of times the data need to be entered by using reference mechanisms such as a relational database;
    - Use consistent terminology;
    - Reduce data to one piece of information per cell; and
    - Document any modifications to the dataset to avoid duplicate error checking.

Quality Control after Data Entry

- Ensure data columns and rows line up properly;
- Look for missing or irregular data entries;
- Perform statistical summaries; and
- Check for outliers using one of the following methods:
    - Graphical methods - Normal probability plots, regression, scatterplots;
    - Maps; and
    - Show deviation of values from the mean.

6.1.3 Additional Opportunities to Access Trash Data

In addition to accessing data via CEDEN, MRP Permittees are also required to submit data and preliminary and final interpretative reports to the Regional Water Board. All data collected via the testing phase of this Monitoring Program Plan will be submitted to the Regional Water Board and made publicly available to interested parties via preliminary and final interpretative reports. The preliminary report will include data collected through the 2018-19 wet season. The final report will include all data collected during the implementation of the testing phase (October 2017 through February 2020). To the extent possible, data results and findings will also be presented to stakeholders in public forums, such as the BASMAA Trash Subcommittee meetings.

6.2 DATA ANALYSIS AND INTERPRETATION

Table 6-1 summarizes the general data analysis methods that will be used to answer the scientific monitoring questions presented in Table 3-2. A discussion of the general data analysis methods that will be conducted are also provided below, along with example figures illustrating data representations.

Evaluating the Data Distributions. Various data characteristics influence which specific statistical test can be used for comparison and other statistical tests. Parametric tests require the data to be normally distributed and that the different data groupings have the same variance, or standard deviation. If the data do not meet the requirements for the parametric tests, the data may be transformed to better meet the test conditions (such as taking the $\log_{10}$ of each observation and conducting the test on the transformed values). Generally, parametric tests have more statistical power than the associated nonparametric tests, but they lose any advantage if inappropriately applied. Commonly applied tests to evaluate the data probability distribution include probability plots and appropriate test statistics for normality, such as the Kolmogorov–Smirnov one-sample test, the chi-square goodness of fit test, or the Lilliefors test.

Table 6-1. Data analysis methods that will be used to evaluate the scientific monitoring questions for the testing phase of the Trash Monitoring Program.

Scientific Monitoring Question	Data Analysis Method					
	Evaluating Data Distribution	Graphical Representation	Cumulative Frequency Analyses	Comparison Tests for Two Data Groups	Comparison Tests for Multiple Data Groups	Evaluation of Correlations
What is the current level of trash deposited in flowing waterbodies in each MRP county; the entire MRP area?	✓	✓	✓			
Are significantly strong correlations observed between qualitative and quantitative methods?		✓				✓
Do trash levels in flowing waterbodies strongly correlate to trash generation levels depicted on Permittee maps?	✓	✓			✓	✓
What is the range of trash levels observed at sites targeted for cleanup? How do these ranges compare to levels in all flowing waterbodies?	✓	✓	✓	✓		
What percentages of trash observed in receiving waters are attributable to stormwater conveyance systems, direct dumping, wind, and encampments.	✓	✓				
Do trash levels in flowing waterbodies differ significantly between wet and dry seasons?		✓			✓	✓

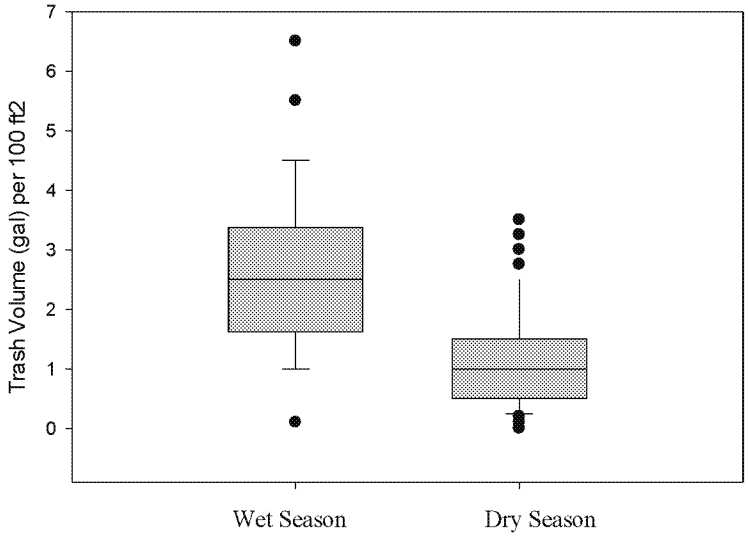
Graphical Representations. Graphical representations of the data are extremely useful for data interpretation and may include time series plots (data observations as a function of time), probability plots, scatter plots, box and whisker plots, bar charts, and pie charts.

- **Probability Plots**. Probability plots indicate the central tendency (median) of the data, along with their possible distribution type and variance (generally, the steeper the plot, the smaller the coefficient of variation (COV), and the flatter the slope of the plot, the larger the COV for the data). Multiple data sets can also be plotted on the same plot (such as for different sites, different seasons, different habitats, etc.) to indicate obvious similarities (or differences) in the data sets. The values and corresponding probability positions are plotted on special normal-probability paper. When plotted on this paper, the values form a straight line if they are normally distributed. If the points do not form an acceptably straight line, they can then be plotted on log-normal probability paper (or the data observations can be log transformed and plotted on normal probability paper). If they form a straight line on the log-normal plot, then the data are log-normally distributed. If the data follow a log-normal distribution many parametric statistical tests can likely be used on the log-transformed data. In addition, most statistical methods used

to compare different data sets require that the sets have the same variances. Similar variances would be indicated by generally parallel plots of the data on the probability paper.

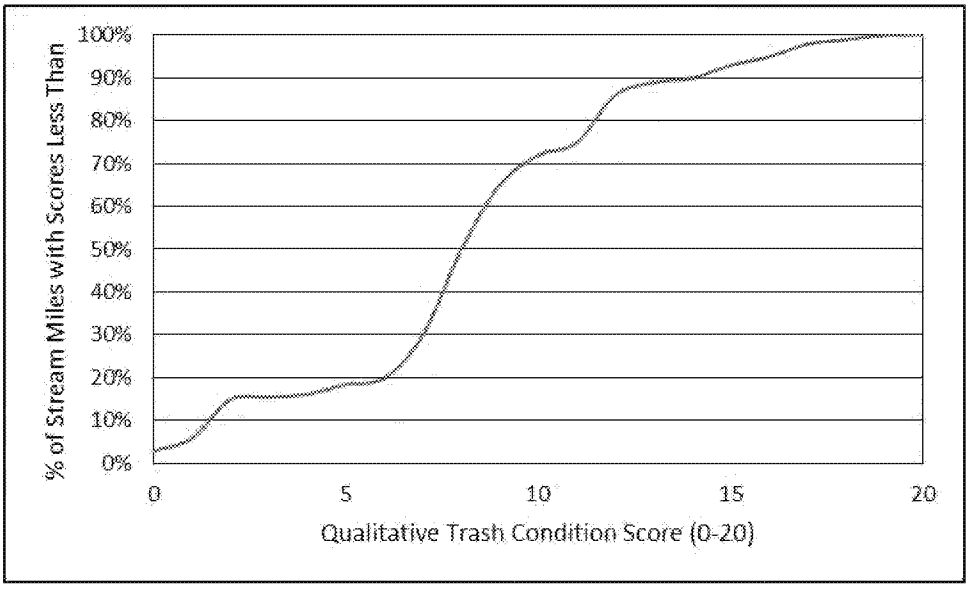
- **Scatter Plots**. Scatter plots are typically made by plotting the primary variable (such as a water quality constituent) against a factor that may influence its value (such as time, season, flow, another constituent like suspended solids, etc.). An example of how scatter plots could be used to evaluate trash data is plotting measured trash generation rates as a function of the antecedent dry weather period. Scatter plots can illustrate whether that relationship appears to be linear or curved, whether different groups of data lie in separate regions of the scatter plot, and whether the variability or spread is constant over the range of data.
- **Box and Whisker Plots**. Box plots provide visual summaries of:
    - the center of the data (the median--the center line of the box)
    - the variation or spread (interquartile range--the box height)
    - the skewness (quartile skew--the relative size of box halves)
    - presence or absence of unusual values ("outside" and "far outside" values).

  Boxplots are particularly useful in comparing these attributes among several data sets. The relative overlapping (or separation) of different data sets on the plots can be used to identify possible groupings of the separate data sets. To supplement the visual presentation with the grouped box and whisker plots, a one-way analysis of the variance (ANOVA) test can be conducted to evaluate if there are any statistically significant differences between the different boxes on the plot. The ANVOA analysis will evaluate if data from the different study areas can be combined to answer certain study design questions make conclusions (which will make the data set more robust in terms of the ability to detect a specific level of change based on the number of samples) because they are similar. An example box whisker plot illustrating trash volumes quantified during the wet and dry s



- **Histograms**. Histograms consist of a series of bars whose height is the number events, or fraction events, of data falling into one of several categories or intervals. Histograms are useful for depicting large differences in shape or symmetry, such as whether a data set appears symmetric or skewed. Histograms could be useful when evaluating how the visual assessment scores correlate to the quantitative trash characterization.

Cumulative Frequency Analyses. Cumulative frequency analysis is the analysis of the frequency that a value or event occurs, such as trash levels or condition. Cumulative frequency analysis is performed to obtain insight into how often a certain value is below or above reference value, such as a median or average. This analysis helps describe the likelihood that a certain value or condition is likely to occur. In the environmental sciences, cumulative frequency analysis is typically conducted to develop a cumulative distribution function, which demonstrate the likelihood that an event or result will occur. For trash monitoring, cumulative frequency analysis will be conducted to establish an ambient condition of trash levels in receiving waterbodies. An example cumulative frequency distribution graph is presented below.

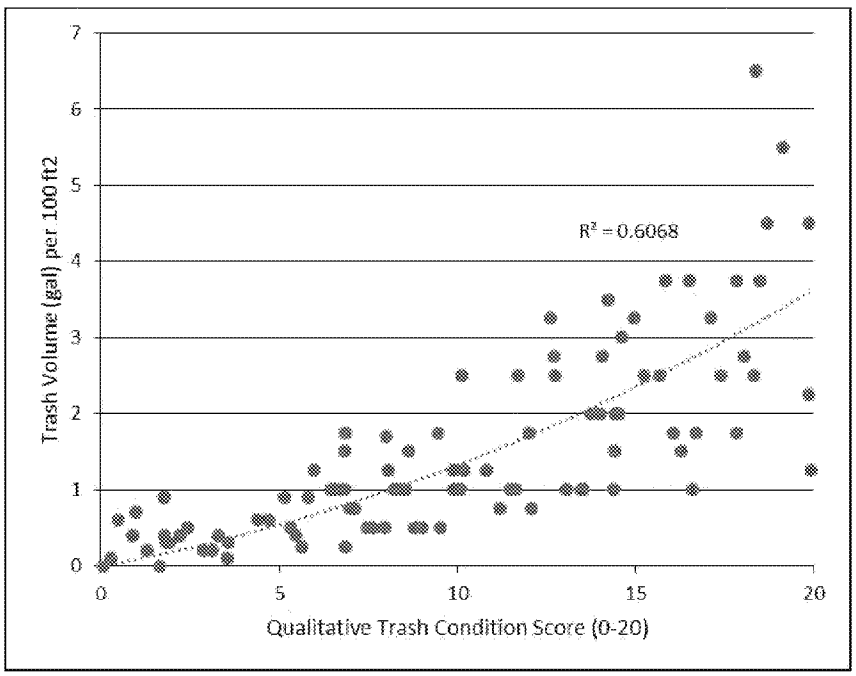


Comparison Tests for Two Data Groups. The most common parametric tests used for comparisons is the Student's *t*-tests. The test requires that the data follow a normal probability distribution (or can be log-normally transformed). The Mann–Whitney signed rank test is an appropriate comparison test for non-parametric data. An example of how this test could be used is evaluating if the visual assessment score or quantitative trash metric is significantly different during wet season and dry season events.

Comparison Tests for Many Groups. ANOVA tests are a set of parametric and non-parametric tests that are used to determine if a set of samples have different means that are based on one or more groupings such as location and time of collection. The number of these groupings, or factor variables, determines if the test is a one-factor, two-factor, etc. design. Parametric ANOVA's require that the data in each grouping as well as their residuals derived from the analysis be

normally distributed and that the variances be the same in each group. An additional requirement is that two-factor designs with a single observation per cell must be additive. Non-parametric versions do not have these requirements, and are applicable to any data with a consequent sacrifice in power. Generally, ANOVA compares the mean values of each group with the overall mean for the entire data set. If the group means are dissimilar, some of them will differ from the overall mean. For a two-factor ANOVA, the influences of two explanatory variables are simultaneously tested. For example, a two-way ANOVA can be used to examine the effects of different seasons and different locations, along with the interaction of these parameters. A two-way ANOVA could be performed on the data to evaluate if the trash data collected varies by site and/or by season if there are no significant interaction effects.

Testing Correlations. Correlation coefficient and regression analyses are conducted to evaluate relationships between different study variables, and can be performed as part of the weight-of-evidence approach that will be used to establish confidence in a proposed cause and effect relationship. For this project, a key analysis will be the correlation between qualitative assessments (i.e., condition scores) and quantitative monitoring (volumes per area). As both types of scores have built-in uncertainty, the appropriate type of regression is Model II. Below is an example regression analysis conducted with fictitious data to illustrate the type of correlation that may be found between the results from the two protocols implemented at the same sites. Similar correlations will also be evaluated between land-based trash generation (as depicted on Permittee trash generation maps) and trash volumes or condition scores in receiving waters.



7. Resource Needs, Schedule and Adaptive Management

7.1 ESTIMATED RESOURCE NEEDS

Because the protocols included in this Monitoring Program Plan are experimental, the resources needed to plan and conduct trash assessments and monitoring are largely unknown. **Table 7-1** includes the preliminary estimated level of effort (person hours) that will be needed to plan, coordinate, and conduct each qualitative assessment and/or quantitative monitoring event described in this Trash Monitoring Program Plan. Estimated hours are for conducting a single qualitative assessment or quantitative monitoring event and do not include QA/QC, data management, interpretation/analysis, or reporting activities.

Table 7-1. Preliminary planning level estimates for the levels of effort (person hours) needed to plan for and conduct each qualitative trash assessment or quantitative trash monitoring event.

Task	Qualitative Assessment [a]	Quantitative Monitoring [b] (includes Qualitative Assessment)
Planning/Preparation	4.0 - 6.0	4.0 - 10.0
Travel	2.0 - 3.0	2.0 - 10.0
Qualitative Assessment	4.0	4.0
Quantitative Monitoring	-	4.0 - 80.0
Disposal of Trash	-	1.0 - 4.0
Total Hours per Event	**10.0 – 13.0**	**15.0 – 108.0**

[a] Assumes 2 person field crew.
[b] Low estimate assumes a two-person field crew. High estimate assumes a ten-person field crew.

7.2 SCHEDULE FOR TESTING PHASE

Per the MRP, monitoring at representative sites must begin no later than October 2017. The proposed schedule for this phase of the Monitoring Program Plan is provided in **Table 7-2.** A Progress report is due to the Regional Water Board on September 2018. A preliminary interpretive report is due by July 1, 2019 and the final report is due on July 1, 2020. The

7.3 ADAPTIVE MANAGEMENT

Although the monitoring described in this Plan is based on protocols and methods previously evaluated (see **Attachment 2**), the protocols included in **Attachment 7** have not been fully tested by Permittees in the SF Bay Area as methods to address MRP management questions. Additionally, the monitoring design (e.g., number of sites, frequencies and timing) that Permittees have agreed to implement during the testing phase is based on a number of simplifying assumptions that will be tested. The results and lessons learned during the testing phase will assist Permittees in adapting the design of the Receiving Water Trash Monitoring

Program Plan to allow more cost-effective and focused data collection during future iterations of the Plan. This may likely include revising the monitoring design to reduce the number of sites and frequency of monitoring needed to address high priority management questions.

Table 7-2. Receiving Water Trash Monitoring Program Schedule*

Date	Action
July 1, 2017	Submittal of Monitoring Program Plan to Regional Water Board
July –August 2017	Approval of Monitoring Program Plan by Regional Board Executive Officer
September or October 2017	Training of Monitoring/Permittee Staff
Wet Season 2017-18 (Oct 2017 – March 2018)	1 Qualitative Event -125 Probabilistic Sites
Dry Season 2018 (Apr 2018 – Sept 2018)	1 Qualitative Event -125 Probabilistic Sites 1 Qualitative & 1 Quantitative - 100 Targeted Sites
September 30, 2018	Progress Report submitted with Annual Reports
Wet Season 2018-19 (Oct 2018 – March 2019)	1 Qualitative Event -125 Probabilistic Sites
Dry Season 2019 (Apr 2019 – Sept 2019)	1 Qualitative Event -125 Probabilistic Sites 1 Qualitative & 1 Quantitative - 100 Targeted Sites
July 1, 2019	Submittal of Preliminary Program Report to Regional Water Board
Wet Season 2020 (Oct 2019 – Feb 2020)	1 Qualitative Event -125 Probabilistic Sites
May 2020	Peer Review of Monitoring/Assessment Results
July 1, 2020	Submittal of Final Program Report to Regional Water Board

*The schedule for trash boom monitoring is not listed here. Quantitative monitoring at trash booms will coincide with boom maintenance and cleaning schedules established by BASMAA member agencies. Cleaning typically occurs prior to and following storm events and the wet weather season (as applicable).

8. References

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Figures

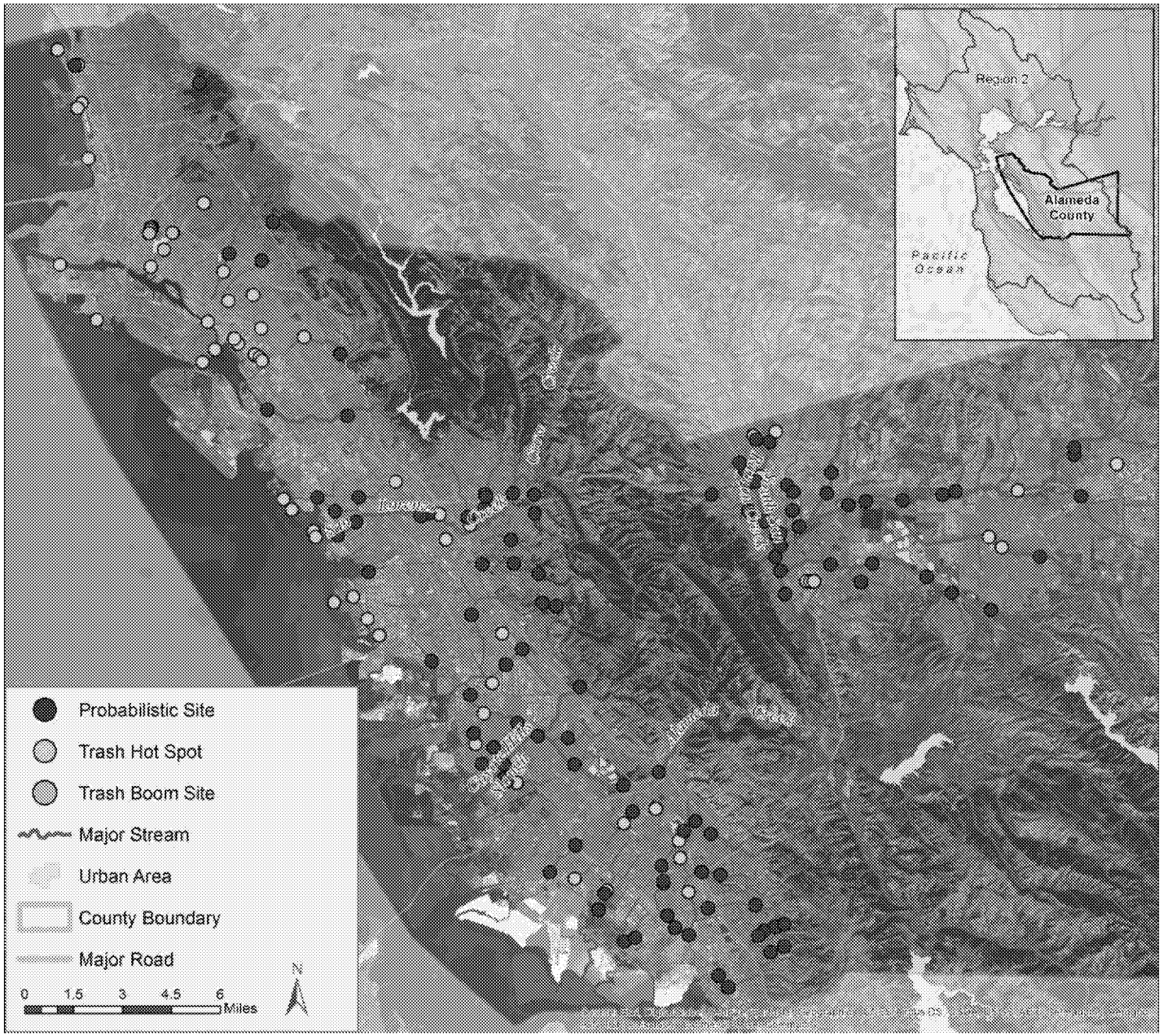

Figure 3-1. RMC Probabilistic, Trash Hot Spot and Trash Boom Sites in Alameda County.

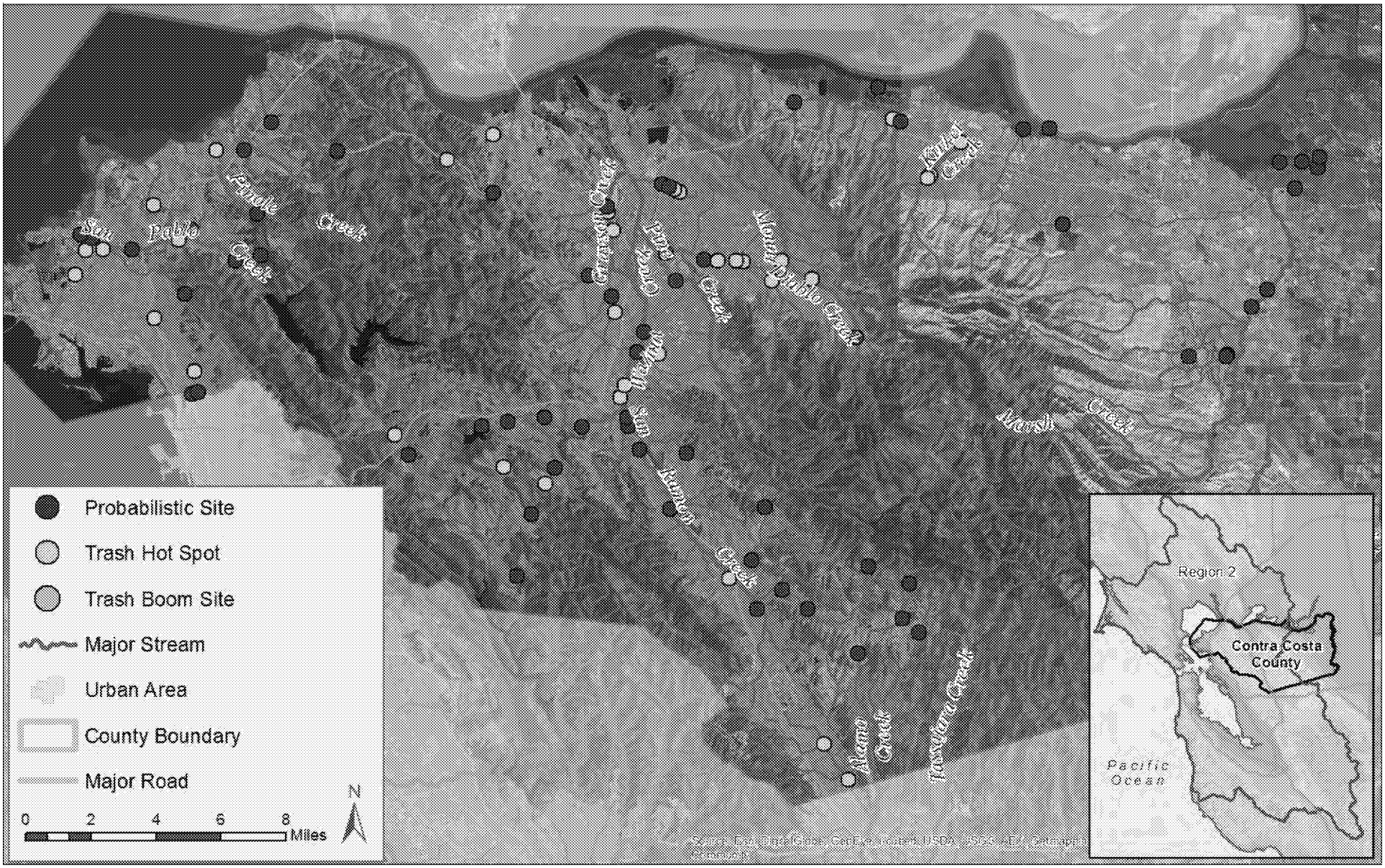

Figure 3-2. RMC Probabilistic, Trash Hot Spot and Trash Boom Sites in Contra Costa County.

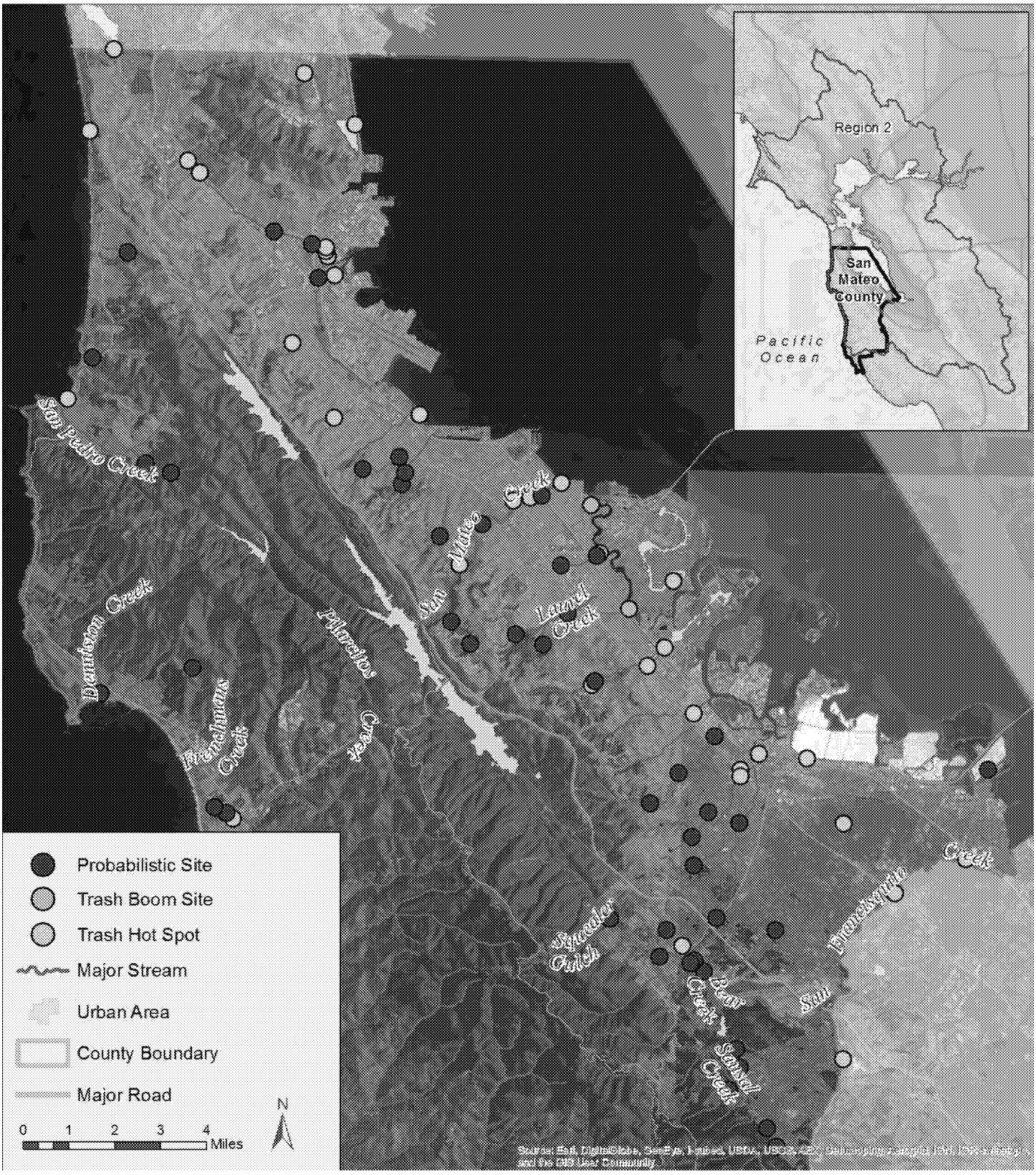

Figure 3-3.RMC Probabilistic, Trash Hot Spot and Trash Boom Sites in San Mateo County.

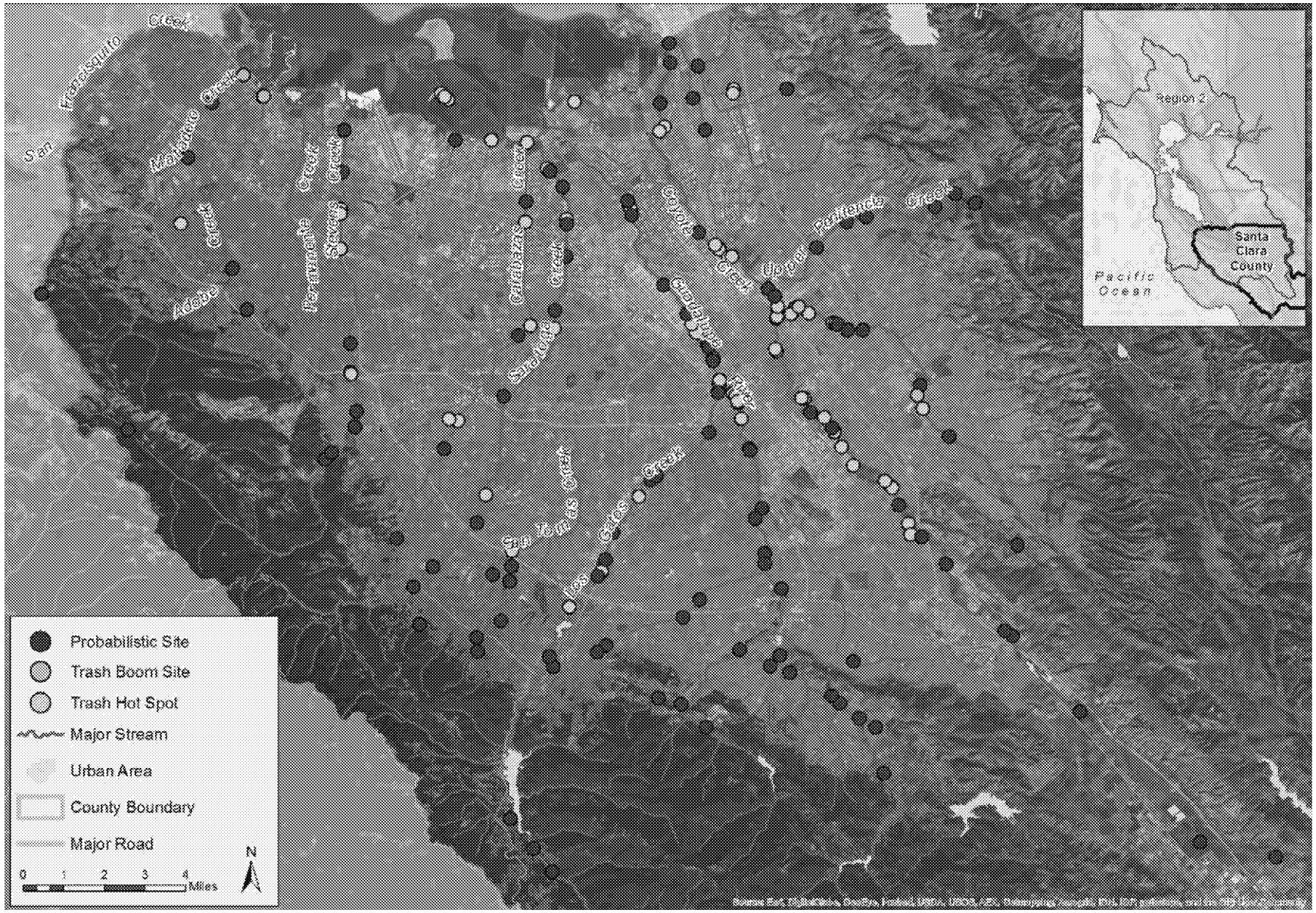

Figure 3-4. RMC Probabilistic, Trash Hot Spot and Trash Boom Sites in Santa Clara County.

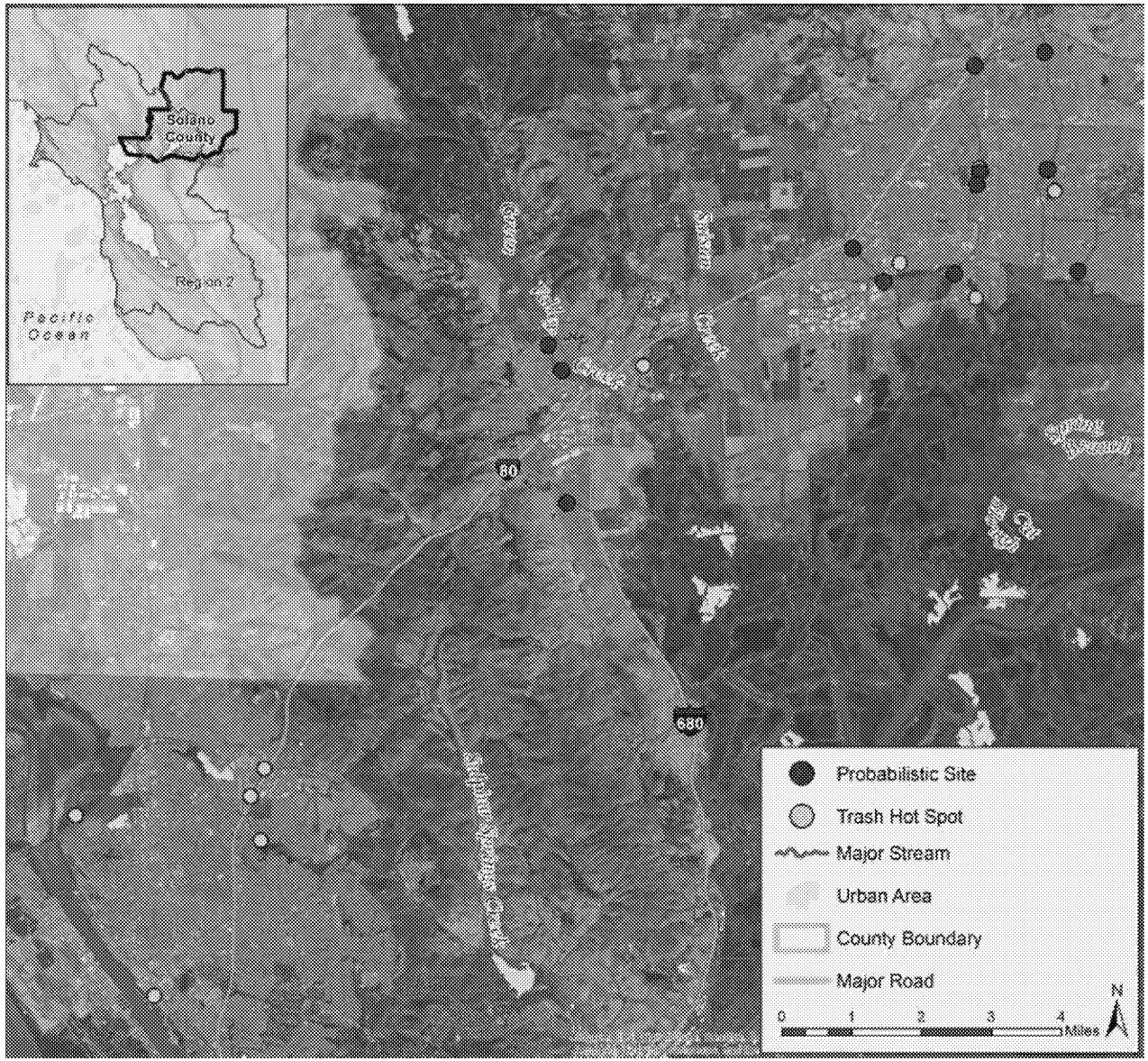

Figure 3-5. RMC Probabilistic, Trash Hot Spot and Trash Boom Sites in Solano County.

Attachment 1

MRP 2.0 Provision C.10.b.v (Receiving Water Trash Monitoring) Requirements and Fact Sheet Language

generation areas reduced to Moderate and Low, and Moderate trash generation areas reduced to Low trash generation category to meet the required total percent reduction ($\%_{Reduction}$) shall be calculated based on the following formula:

$$\% \text{ Reduction} = 100\ [(12A_{VH(2009)} + 4A_{H(2009)} + A_{M(2009)}) - (12A_{VH} + 4A_H + A_M)] \\ / (12A_{VH2009} + 4A_{H2009} + A_{M2009})$$

where:

$A_{VH(2009)}$	=	total amount of the 2009 very high trash generation category jurisdictional area
$A_{H(2009)}$	=	total amount of the 2009 high trash generation category jurisdictional area
$A_{M(2009)}$	=	total amount of the 2009 moderate trash generation category jurisdictional area
A_{VH}	=	total amount of very high trash generation category jurisdictional area in the reporting year
A_H	=	total amount of high trash generation category jurisdictional area in the reporting year
A_M	=	total amount of moderate trash generation category jurisdictional area in the reporting year
12	=	Very High to Moderate weighing ratio
4	=	High to Moderate weighing ratio
100	=	fraction to percentage conversion factor

iv. **Source Control** – Permittee jurisdiction-wide actions to reduce trash at the source, particularly persistent trash items, may be valued toward trash load reduction compliance by up to ten percent load reduction total for all such actions. To claim a load percentage reduction value, Permittees must provide substantive and credible evidence that these actions reduce trash by the claimed value. A Permittee may reference studies in other jurisdictions if it provides evidence that the implementation of source control in its jurisdiction is similarly implemented as the source control assessed in the reference studies.

* v. **Receiving Water Monitoring** – Permittees shall conduct receiving water monitoring and develop receiving water monitoring tools and protocols and a monitoring program designed, to the extent possible, to answer the following questions:

- Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s)?
- Is trash present in receiving water(s), including transport from one receiving water to another, e.g., from a creek to a San Francisco Bay segment, at levels that may cause adverse water quality impacts?
- Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?
- Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?

The monitoring tools and protocols shall include direct measurements and/or observations of trash in receiving water(s), or in scenarios where direct measurements or observations are not feasible, surrogates for trash in receiving waters, such as measurement or observations of trash on stream banks or shorelines.

a. **Development and Testing Plan** – Permittees shall submit a plan acceptable to the Executive Officer by July 1, 2017, to develop and test a proposed receiving water monitoring program that includes the following:
   (i) Description of the tools and protocols;
   (ii) Description of discharge and receiving water scenarios, which will be considered, that accounts for the various receiving waters and watershed, community, and drainage characteristics within Permittees' jurisdictions that affect the discharge of trash and its fate and effect in receiving water(s);
   (iii) Description of factors, in addition to those in C.10.b.v.a.(ii), that will be considered and evaluated to determine scenarios and spatial and temporal representativeness;
   (iv) Identification of sites, representative of all the Permittees and discharge and receiving water scenarios, that will be monitored during this permit term;
   (v) Development of a system to manage and access monitoring results;
   (vi) Opportunity for input and participation by interested parties;
   (vii) Scientific peer review of the tools and protocols and testing results; and
   (viii) Schedule for development and testing; with monitoring at representative sites starting no later than October 2017.

   If the Permittees conduct this work through an independent third party, approved by the Executive Officer, the Plan may be submitted by July 2018, with monitoring to begin no later than October 2018.

b. **Report and Proposed Monitoring Program** – Permittees shall report progress in the 2018 Annual Report, and submit a preliminary report by July 1, 2019 and a final report by July 1, 2020 on the proposed trash receiving water monitoring program. The progress report is not required if the Permittees conduct this work through an independent third party, approved by the Executive Officer, that provides input and participation by interested parties and scientific peer review of the tools and protocols and testing results and proposed receiving monitoring program.

C.10.c. Trash Hot Spot Selection and Cleanup

Trash Hot Spots in receiving waters shall be cleaned annually to achieve the multiple benefits of abatement of impacts and to learn more about the sources and transport routes of trash loading.

i. **Trash Hot Spot Cleanup and Definition** – The Permittees shall clean selected Trash Hot Spots to a level of "no visual impact" at least one time per year for the

reduction compliance value of up to ten percent load reduction total for all such actions. This would be added to the % Reduction amount calculated by the C.10.b.iii - Percentage Discharge Reduction formula in demonstrating attainment of the percent trash load reduction deadline requirements and performance guideline. To claim a load percentage reduction value, Permittees must provide substantial evidence that these actions reduce trash by the claimed value. A Permittee may reference studies in other jurisdictions if it provides evidence that the implementation of source control in its jurisdiction is similarly implemented as the source control assessed in the reference studies. Source control load reduction value(s) will be reviewed during reissuance of the Permit, and value(s) for source control load reductions might not be continued and allowed in the next permit, particularly in areas where the value of source controls will be accounted for in observed reductions in trash in trash generation areas, to avoid double counting. Also, the focus of the next permit will move to attainment of the 2022 goal and consideration of receiving water condition compliance indicators, and source control load reduction values may no longer be relevant.

* **C.10.b.v. Receiving Water Monitoring** – Receiving water monitoring for trash provides additional evidence and can verify that full trash capture systems and other trash management actions are preventing trash from discharging into receiving waters and whether additional actions may be necessary associated with sources within a Permittee's jurisdiction. They can also show whether there are ongoing sources outside of the Permittee's jurisdiction that are causing or contributing to adverse trash impacts in the receiving water(s). There are currently no standard methods and protocols for monitoring trash in receiving waters. However, BASMAA is developing and testing some trash monitoring tools and protocols via a California Proposition 84 grant funded project (Agreement # 12-420-550), *Tracking California's Trash*. During this Permit term, the Permittees will develop and test trash receiving water monitoring tools and protocols designed, to the extent possible, to answer the following questions:

1. Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s)?
2. Is trash present in receiving water(s), including transport from one receiving water to another, e.g., from a creek to a San Francisco Bay segment, at levels that may cause adverse water quality impacts?
3. Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?
4. Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?

The monitoring tools and protocols may include direct measurements and/or observation of trash in receiving waters. In scenarios where direct measurements or observations are not feasible, surrogates for trash in receiving waters, such as measurement or observation of trash on shorelines or creek banks may provide a practicable means of monitoring trash. This includes consideration and appropriate simplification of the shoreline and creek bank trash assessment method developed by

Water Board staff, *Rapid Trash Assessment Method Applied to Waters of the San Francisco Bay Region: Trash Measurement in Streams. Surface Water Ambient Monitoring Program.* April 2007.

> The goal is to establish the least expensive and simplest to use monitoring methods and protocols that are applicable to the various discharge and receiving water scenarios that accounts for the various receiving waters and watershed, community, and drainage characteristics within Permittees' jurisdictions that affect the discharge of trash and its fate and effect in receiving water(s). These and other factors, such as feasibility, location logistics, types of trash, complexity, and costs, provide a means to focus and limit the number of monitoring tools and protocols, and determine spatial and temporal representativeness of the tools and protocols, representativeness of scenarios that will be tested.
>
> Keys to establishing the least expensive and simplest to use monitoring methods and protocols include: their acceptance and use by interested parties; ensuring their scientific integrity by having them peer reviewed; and a user-friendly system to manage and access monitoring results. To provide a balance between allowing time to develop and test the tools and protocols and allowing enough time to review the proposed monitoring program in advance of reissuance of the Permit, Permittees must submit a preliminary report on the proposed monitoring program by July 1, 2019, a year in advance of the final proposed monitoring program due July 1, 2020, six months before the Permit expires. This should allow for early resolution of some monitoring program issues that are not dependent on completion of tests. Given the interest in receiving water monitoring by multiple parties, Permittees are encouraged to conduct development and testing of the tools and protocols and development of the monitoring program through an independent third party, such as the San Francisco Estuary Institute, that provides for interested party participation and scientific peer review of the work. Permittees will not be required to submit the preliminary monitoring program report if the work is conducted by an independent third party.

C.10.c. Trash Hot Spot Selection and Clean Up

The previous permit included a requirement for Permittees to cleanup a minimum number of Trash Hot Spots in receiving waters or on shorelines or creek banks associated with their jurisdictions. Trash Hot Spot cleanups remove trash discharged from a Permittee's jurisdiction and lessen the adverse impacts from the discharges until they are abated by a Permittee's trash management actions. Trash Hot Spot cleanups have an added benefit in that may also remove discharges of trash from non-storm drain sources, e.g., direct dumping or homeless encampments. They also provide an additional means of assessing the effectiveness or Permittees' trash management actions and identification of the types and sources of trash. The required Trash Hot Spot assessment is based on the SWAMP Rapid Trash Assessment Protocol.

C.10.d. Trash Load Reduction Plans

The previous permit required Permittees to prepare a Plan to achieve the 2017 and 2022 trash reduction deadline requirements. A Trash Load Reduction Plan provides a means for Permittees to determine and account for appropriate trash management actions in their

Attachment 2
Summary Review of Historical and Current Receiving Water Monitoring Efforts, Methodologies and Protocols for Trash

ATTACHMENT 2

REVIEW AND EVALUATION OF MONITORING TOOLS AND PROTOCOLS

As a first step in the development of the Standard Operating Procedures (SOPs) included in **Attachment** 7, BASMAA reviewed and evaluated existing and potential tools and protocols that could be employed to meet the goals of the receiving water trash monitoring program and the trash receiving water monitoring requirements of the MRP. The review and evaluation consisted of a survey of stakeholders and trash monitoring personnel to solicit input and insight on potential tools, as well as a review of existing and potential monitoring approaches, strategies, and protocols. The evaluation also included a literature review of potential tools that could be employed in the Bay Area to make monitoring, data collection, assessment, and reporting more efficient. Research was performed to compile the various approaches that trash monitoring programs currently employed around the State, in addition to results of the survey conducted of project stakeholders. Aside from the BASMAA Receiving Water Trash Monitoring Stakeholder Survey[1], a valuable reference for this work was the *Tracking California's Trash (TCT) Project Literature Review* (BASMAA, 2014), which summarized approaches used in San Diego, Orange County, Los Angeles, Ventura County, and the San Francisco Bay Area, as well as available protocols from other states and countries.

Based on the programs that were reviewed, trash monitoring programs, regardless of their location across the state, generally based their protocols on SWAMP's *Rapid Trash Assessment (RTA)* protocol, the *Keep America Beautiful (KAB)* protocol, or other, similar visual observation methods. Upon completion of the review and evaluation, a recommended list of assessment methodologies and tools that potentially would assist MRP Permittees in addressing MRP management questions, and were consistent with the goals and objectives of the Trash Monitoring Program Plan, was developed for further evaluation. These methodologies were identified as potentially being used in the many discharge and receiving water scenarios found throughout the San Francisco Bay Region.

Trash monitoring and assessment methods can be divided into two general categories: (1) qualitative visual surveys; and (2) quantitative surveys. For **qualitative** visual surveys, trained observers assign a score (e.g., 1, 2, 3, 4 or A, B, C, D) to a site based on the trash conditions found at monitoring sites. The score is based on a defined scale. That is, a site with low trash conditions would be assigned a score of "1" or "A" and a site with high trash conditions would be assigned a score of "4" or "D". Examples of this method are the Keep America Beautiful (KAB, 2009) Litter Index, the Keep Britain Tidy (KBT, 2013) Grades of Cleanliness, and the Bay Area Visual On-land Trash Assessment Protocol for Stormwater (EOA, 2015). For each example, a site can be defined in any manner (e.g., grid, transect, covering a shoreline, curbline), which provides flexibility for this type of method. However, it is beneficial to define categories of sites in a similar manner to allow for comparable results. The results of the monitoring may be used to determine trends in trash amounts (volume has

[1] The BASMAA Receiving Water Trash Monitoring Stakeholder Survey was conducted in October and November 2016 and garnered ten responses. Results from the survey were used to compile and evaluate existing tools and methodologies for trash monitoring. The survey was distributed via www.surveymonkey.com and results are available upon request.

been identified by the Regional Water Board as the preferred measurement), and identify possible trash accumulation areas.

For **quantitative** surveys, trained personnel collect, count/weigh/determine volume, and/or characterize (types, sizes, etc.) trash found at the monitoring sites. The quantitative data and trash characterization can be used to determine trash accumulation areas and trends in trash amounts and to identify any possible trash sources. Quantitative methods often require more effort than the qualitative visual survey method due to the collection, counting/weighing/determining volume, and/or the characterization of the trash found at the monitoring sites.

In some cases, qualitative and quantitative methods may be combined into a semi-quantitative method where scoring categories are used based on the number of pieces of trash found at the monitoring sites (e.g., 1 = 0-10 pieces, 2 = 11-25 pieces, 3 = 26-50 pieces, 4 = >50 pieces). The semi-quantitative method can be beneficial as the level of effort is similar to the qualitative visual survey method, but still provides a quantitative aspect to the data.

The evaluation of monitoring approaches was coupled with an evaluation of potential monitoring tools that could be utilized to ensure that monitoring, data collection, assessment, and reporting are performed as efficiently as possible. The list of potential tools developed through the survey and literature review was narrowed to focus on the most feasible tools, while still meeting the monitoring criteria listed below.

Ranking Criteria and Scoring of Existing Trash Monitoring Protocols

The potential tools and protocols were evaluated against the criteria outlined in the main body of the Monitoring Program Plan. A total of 45 protocols were identified during the literature review and survey, and were then evaluated and scored using the ranking criteria to determine which have the best potential for addressing the BASMAA Receiving Water Trash Monitoring Program questions and goals. All 45 monitoring protocols were summarized and each protocol was assigned a score of 1, 2, or 3, as summarized in **Table A2-1**. Protocols receiving a score of "1" were evaluated in more detail, as discussed below. Protocols receiving a score of "2" may be worth considering in the future, but do not currently meet the needs of the Monitoring Program Plan. Protocols receiving a score of "3" are not applicable to this type of Monitoring Program. Summaries of the 13 protocols receiving at score of "1" are provided in **Table A2-2**.

Table A2-1. Receiving Water Monitoring Protocol Scoring Scale

Score	Basis
1	• Data collected could help answer several monitoring questions (presence/absence, assessment of trash control actions, sources, transport). • Data collected could help inform management decisions (via trends, sources). • Data collected will be compatible with existing/required programs (past and present, Statewide Trash Amendments). • Different stream types are represented (creek, channel, shoreline, etc.). • This method is used for wet and dry weather, or can be adapted to do so. • The relative costs and training requirements seem feasible for a regional program. • This method is applicable to the Bay Area. • The benefits exceed the limitations. • Components of this method could be useful in the development of a modified method.
2	• Data collected could help answer one or more monitoring questions (presence/absence, assessment of trash control actions, sources, transport). • It is less clear if data collected from this protocol could help inform management decisions (via trends, sources). • This method does not add anything new to the more vetted methods. • The relative costs and training requirements seem less feasible for a regional program at this time. • This method does not seem as applicable to the Bay Area. • The benefits and limitations are fairly even.
3	• This is an on-land method. • This is a method for microplastics only. • This method is not applicable to the Bay Area.

Findings and Recommended Monitoring Approach

Many of the receiving water trash monitoring tools identified from the literature review and Stakeholder Survey were derived from the RTA. Method(s) employed in a regional receiving water trash monitoring program need to: 1) reduce the influence of confounding variables, 2) be standardized to an assessment area to allow data from different sites to be compared, 3) consider the minimum level of change that users hope to observe within a set degree of statistical confidence, and 4) control for differences in monitoring personnel. Specifically, a regional program should include:

- Selection of a method for the monitoring, or establish clear guidelines if different methods can be used for different types of receiving waters (e.g., urban creeks vs. coastal shorelines);
- To allow for comparison across sites, clear documentation of the size of the area where the monitoring or assessments are conducted;
- Identification of common weather conditions for monitoring uniformity;
- Documentation of antecedent conditions/watershed activities –most recent cleanup event or special event that may have resulted in higher or lower trash;
- Protocols for frequency and methods to normalize for more or less frequent monitoring;
- Guidance for assessing impacts from illegal encampments and illegal dumping (direct discharges);
- Standard training or instructions for monitoring personnel:

    - Account for different needs of volunteer vs. professional monitoring personnel;
- Standard data collection/documentation methods; and
- Standard data management methods that are based on the data collection fields.

From the review and evaluation of 45 monitoring protocols, a shortened list of 13 protocols (**Table A2-2**) was developed for further review for use in this Monitoring Program Plan.

Table A2-2. High-ranking Trash Monitoring and Assessment Protocols.

	Protocol	Agency/ Organization	Applicable Monitoring Location
1	Urban RTA (RTA modified for urban creeks). Modified scoring ranges from SWAMP RTA to provide more evenly distributed range of trash conditions to increase the resolution of data for evaluating changes at trash impacted sites. Documents total volume of trash collected and estimates relative number and type of trash source.	Santa Clara, San Mateo, Alameda Counties	Banks, Shorelines
2	San Diego Trash Assessment Worksheets. A qualitative estimate of the presence of trash is determined and documented on the Trash Assessment Form. This is a qualitative assessment which should reflect a first impression of the site. There are five categories to describe the amount and extent of trash at each site. Trash type is also recorded.	County of San Diego MS4 Co-Permittees	Banks, Shorelines
3	Guadalupe River & Coyote Creek Trash Assessments. Staff monitoring trash accumulation points via driving/walking. A Trimble YUMA device with ArcPad was used to record information on each trash accumulation point. This included GPS location, stream stationing, location description, most prevalent trash types, potential pathways/sources, and a cubic yard estimate.	Santa Clara Valley Water District (SCVWD)	Banks, Shorelines, channels (i.e., accessible areas)
4	Revolon Slough Trash Management and Reporting Plan. Collection of pieces/weight/volume from receiving water locations and visual screening of receiving water locations.	Ventura County	Banks, Shorelines
5	Annual coastal cleanup day data collection activities. Items counts and total trash weights are recorded.	The Watershed Project; Contra Costa and Alameda Counties	Banks, Shorelines
6	Hot Spot Assessments - Cleanups and Trash Hot Spot Cleanup Data Collection Form per San Francisco Bay Regional MRP	San Francisco Bay Area	Banks, Shorelines
7	SCVURPPP Photograph Documentation Protocol for Creek and Shoreline Trash Hot Spots protocol - Documents trash conditions before and after the clean-up event of the entire hot spot with a minimum of one photo per 50 ft. of hot spot length.	Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)	Banks, Shorelines
8	Trash Boom - floatation structures with suspended curtains used to collect floating trash.	Cities of Oakland & Palo Alto; SCVWD; County of Los Angeles; Queens, NY; Albuquerque, NM; Melbourne, AUS, etc.	Lakes, Lagoons, Reservoirs, Creeks, Channels, Ocean

	Protocol	Agency/ Organization	Applicable Monitoring Location
9	SWAMP RTA. Forms are used to collect information on level of trash, actual number of trash items found, threat to aquatic life, threat to human life, illegal dumping, illegal littering, accumulation of trash, and type of trash (i.e. plastics, biohazards, etc.).	Developed by SFRWQCB; used Statewide	Banks, Shorelines, and trash visible within stream channel
10	San Diego Creek Refuse Assessment Program - The RTA method designed by the City (a) assesses the overall trash conditions through a rating scale, (b) characterizes the observed trash, and (c) calculates total trash volumes based on estimated site dimensions and percent cover.	City of San Diego	Banks, Shorelines
11	Los Angeles Trash Monitoring and Reporting Plan - Visual monitoring as well as use of nets to collect trash from a site 300 yards in length to record sizes and categories of trash. Information collected includes weight, volume, and number of pieces. Information is later used to calculate mass loading based on charts of known weights of common items. Screening process for site selection includes ranking 1-5.	City of Los Angeles	Banks, Shorelines, Creeks, Channels
12	San Jose Trash Monitoring and Reporting Plan - Study to monitor 6 hot spots, 1x/year, during dry weather. Data collected include weight and volume of trash removed, types of trash removed (8 categories for characterization), and estimate of proportion of trash from municipal separate storm sewer system (MS4) and non-MS4 sources. Includes qualitative (RTA-based) and quantitative methods. Provides list of typical pathways for common trash items and 8 categories for classifying trash. Protocol includes photo documentation.	City of San Jose	Banks, Trash visible within Creeks and Channels and Shorelines
13	NOAA Marine Debris Shoreline Survey Field Guide For Standing-stock studies - Debris within discrete transects at the shoreline site is tallied during standing stock surveys. Debris density reflects the long-term balance between debris inputs and removal and is important to understanding the overall impact of debris.	NOAA	Shorelines

REFINEMENT OF EXISTING MONITORING TOOLS AND PROTOCOLS

The protocols in the short list (13) included in **Table A2-2** were further evaluated to determine their applicability towards the MRP trash management questions and monitoring goals and objectives. The *Rapid Trash Assessment (RTA)* method developed by the San Francisco Bay Regional Water Board's Surface Water Ambient Monitoring Program (SWAMP) (SFBRWQCB, 2017) was one of the short-listed protocols that many of the other protocols either referenced or appeared to be based upon. SWAMP's objective in creating the RTA was to examine the amount and types of trash present in stream channels, the effects of trash on beneficial uses, and potential sources of trash (SFBRWQCB, 2017). The report evaluated data based on a one-year survey of 26 sites throughout the San Francisco Bay region. A total of 93 site assessments were conducted at these sites. The report discusses dry and wet weather trash deposition rates in urban settings, longitudinal variability within watersheds (e.g., how trash levels varied from the headwaters to the mouth of a waterbody), and variability across watersheds in urban settings.

The RTA protocol includes qualitative assessments of the trash "condition" at a site (100 feet in length) based on the first impression of a field team, consisting of two observers. The trash condition includes level of trash, threat to aquatic life, threat to human health, illegal dumping and littering, and accumulation of trash. The protocol also includes a quantitative assessment of the total number of trash items found within the 100-foot reach, based on trash collected from the assessment area.

Some limitations noted[2] for the RTA include:

- Does not specify the creekside environment where the method can be used;
- Does not specify the antecedent flow condition required for the method to be applied;
- Does not discuss the need to document recent clean up events; and
- Trash items are counted rather than estimated based on volume. Volume may be a more meaningful measurement for assessing impacts.

Additional limitations of the RTA include conservative scoring ranges for condition categories and the assumption that a particular type and/or number of trash items are directly associated with an impact to aquatic life uses or effects on human health.

Of the 12 other short-listed protocols, five protocols were explicitly derived from the RTA, or have some components that originated directly from the RTA. **Table A2-3** summarizes the contents of each of the 13 short-listed protocols, the specific components that were evaluated for incorporation into the Monitoring Program Plan, and how each protocol addresses the monitoring questions and goals.

The trash monitoring and assessment protocols that are included in **Attachment 7** and will be used during the pilot-testing phase of the Monitoring Program Plan were primarily derived from:

- The SWAMP RTA (SFBRWQCB, 2007); and
- The City of San Jose Trash Receiving Water Monitoring Plan (City of San Jose, 2016).

In addition, information from the Center for Watershed Protection (CWP) Unified Stream Assessment Manual, which was not part of the Short List of Protocols, was used to document the vegetation condition of the receiving water (Center for Watershed Protection, 2004). Documentation of vegetative conditions is believed to be an important component of the

[2] Personal communication with Dale Bowyer, SFBRWQCB, January 31, 2017.

monitoring program and is a factor not significantly considered by RTA or most other monitoring protocols.

CONSIDERATION OF EMERGING TECHNOLOGIES

In addition to the evaluation of existing field monitoring methods for trash, emerging technologies that may provide more efficient monitoring of trash conditions in receiving waters were also identified. The identified emerging technologies included tools such as the use of unmanned aerial vehicles (UAVs), fixed cameras, and trash flux monitoring. Little information was available on these technologies for monitoring trash in receiving waters. A brief summary of these emerging technologies is provided below.

Unmanned Aerial Vehicles

A UAV, more commonly known as a drone, is an aircraft without a human pilot aboard. UAVs are a component of an unmanned aircraft system (UAS), which include a UAV, a ground-based controller, and a system of communications between the two. The use of UAVs for trash monitoring would involve flying over receiving waters to visually document the levels of trash observed. Conceptually, the application of UAVs in trash monitoring programs are generally constrained by three factors: 1) the resolution of the camera; 2) the ability of the camera to detect different types of trash; and 3) the obstruction of the camera by vegetation and other materials. Additional factors that would need to be considered when using drones for trash monitoring would include costs, obtaining a pilot's license and insurance, and the time needed to analyze digital imagery. Additionally, regulations enforced by the Federal Aviation Administration limit the areas where drones may operate.

Because there are no existing programs using drones to monitor trash in receiving waters, and the many factors that would need to be addressed prior to applying this technology, the use of UAVs as a method to address the trash management questions outlined in the MRP was not recommended during the pilot-testing phase of the Trash Monitoring Program. The PMT agreed, however, that this technology may be promising in the future and should continue to be tracked for potential application in the future. Based on a recent conversation among staff from the SF Bay National Estuarine Research Reserve (NERR), San Francisco Estuary Institute (SFEI), US EPA, Regional Water Board, and Bay Area Stormwater Program staff, UAVs or manned aerial vehicles are currently used to obtain spectral imagery of Bay wetlands, watersheds, and land areas for a variety of applications. Based on this conversation, representative from SFEI, Bay Area Stormwater Programs and US EPA agreed to further discuss potential pilot-testing of these technologies with stakeholders of the SF Bay Regional Monitoring Program (RMP), with consideration of RMP funding to further evaluate these technologies and their application in trash monitoring.

Cameras

The use of cameras to assess trash levels in receiving waters may be useful when conducting assessments in inaccessible or dangerous locations, or for longer assessing levels over longer timeframes than traditional assessment procedures. The complexity of the image capturing system depends on the site and surrounding environment. For in-water monitoring, remotely operated vehicles (ROV) along with high-resolutions cameras would be necessary to conduct visual trash assessments. A single waterproof camera installed in an elevated viewing location

may be sufficient to conduct monitoring at an assessment area. Typically, video footage would be reviewed by staff and assessed using visual observation procedures. For receiving waters, footage could conceptually be used to count floating trash passing through the view area to estimate trash loads. Photographic cameras could also be used to conduct continuous monitoring. Camera systems could be installed to snap photos in time intervals. Images would then be reviewed by staff, and through image recognition techniques, images would be used to track trash accumulation.

With current camera systems, there is a trade-off between area viewed and resolution required to identify trash. In the *2016 Trash Receiving Water Monitoring Protocols Pilot Study*, the City of Los Angeles was unable to use video footage of a 300-feet length view area due to the poor resolution of the images (City of Los Angeles, 2016). The City recommended cameras with greater zooming capability and higher resolution. Higher resolution cameras, however, tend to be more expensive. Additionally, the usefulness of camera systems may be limited to the daytime, as most night vision technologies have lower resolution, consume significantly more battery power, and collected photographs will likely not show trash under the water surface or under vegetation, resulting in an under estimation of trash present. The use of cameras would also require installation and maintenance, as well as data retrieval and analysis. There are also issues with cameras being vandalized or stolen.

Based on the limited success of using camera to assess trash levels in receiving waters, Bay Area Permittees will track the use fixed or underwater cameras by the City of Los Angeles and other researchers during the pilot-phase of the Bay Area Trash Monitoring Program. Lessons learned may help answer trash monitoring questions in the future.

Flux Monitoring

As part of the *Tracking California's Trash (TCT)* project, BASMAA conducted a pilot study in 2015-16 in collaboration with 5 Gyre Institute to evaluate methods that could be used to monitor the levels of trash flowing in receiving waters under varying hydrological conditions (BASMAA, 2017). During the pilot study, trash flux monitoring was conducted by using a variety of trawls to capture trash flowing in receiving water at different depths. During wet weather events, the trawls were installed at the beginning of a storm to document the rising hydrograph. A flow meter was attached to each trawl to measure the velocity of the water. Trawls were deployed mechanically by a USGS Crane, but could have been deployed by hand in low flow water with the appropriate State and local permits. Trash collected from the receiving waters was characterized using procedures included in the project's Sampling Analysis Plan (BASMAA, 2014b).

Based on the findings of the TCT project, the flux monitoring method is still in development because several challenges and deficiencies were noted. It was recognized that sampling is time-consuming due to the uncertainty of storm tracking, extensive pre-planning to mobilize and deploy equipment, and perform trash characterizations. Equipment malfunctions were observed as the flow meters used with the trawls did not perform well during low and high flows. Flow meters were blocked by trash and debris, resulting in inconsistent measurements. Furthermore, setting up the USGS Crane was difficult and posed safety hazards, especially at higher flow velocities. Problems with crane stability were encountered in multiple monitoring events in flows as low as 19 cubic feet per second. Additionally, traffic control was required at most of the sites.

Overall, flux monitoring was shown to be expensive and time-consuming. The required permits were difficult to obtain and imposed limits on sampling equipment that could be used and furthermore did not allow for monitoring during special municipal events. Overall, the information collected during the BASMAA study pertained more toward monitoring equipment rather than providing information to answer the monitoring goals and questions trying to be answered via the Monitoring Program Plan.

As a result of the findings and lessons learned via the TCT project and the lack of nexus between these methods and the trash management questions included in the MRP, flux monitoring methods were recommended for incorporation into the pilot-testing phase of the Trash Monitoring Program Plan. In essence, pilot-testing the flux method was conducted via the TCT project. Lessons learned via the TCT project on flux monitoring will be considered, along with lessons learned via methods and protocols employed during the pilot-testing phase, when developing recommendations for future trash monitoring that will be presented in the final report on trash receiving water monitoring, due to the Water Board in July 2020.

Summary of Recommendations

Although technologies that may improve the efficiencies and standardization of trash monitoring are promising, many issues remain with the application of these methods to monitor trash in receiving waters. For these reasons, the use of these technologies at this phase of the monitoring program was not recommended. As more on-the-ground knowledge is obtained, these technologies may assist MRP Permittees with answering future trash management questions. Therefore, advances in the application of these methods will continue to be tracked and evaluated during this pilot-testing phase. Additionally, MRP Permittees will continue to discuss opportunities to test these technologies via the RMP and other monitoring forums over the course of the pilot-testing phase.

Table A2-3. Summary of Elements Used from the Short List of 13 Monitoring Protocols to Develop Receiving Water Trash Protocols

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
1	Original RTA	SWAMP RTA. Data forms are used to collect information on level of trash, actual number of trash items found, threat to aquatic life, threat to human life, illegal dumping, illegal littering, accumulation of trash, and type of trash (i.e. plastics, biohazards, etc.). See Figure 3.1 for RTA Trash Data Sheets.	Developed by SFBRWQCB; used Statewide	• Qualitative Trash Condition Category including assessment of illegal dumping and littering, and downstream transport. • Site definition delineation including delineating High Water line. • Item counts for various types of trash above and below the high water line, including tally f items suspected for littering, dumping or downstream accumulation.	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts? • Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)? • Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	• Informs management decisions • Accounts for different stream and channel types, and considers temporal variability (e.g., to estimate baseline conditions and show change over time) and seasonality • Can assess trends over time • Allows for comparison of trash levels between sites (understand the range of levels of impact) • Assists in determining relative contributions from different pathways (i.e., wind, illegal dumping, illegal encampments, and MS4s). • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups).
2	RTA	Urban RTA (modified RTA for urban creeks). Modified scoring ranges from SWAMP RTA to provide more evenly distributed range of trash conditions to increase the resolution of data for evaluating changes at trash impacted sites. Documents total volume of trash collected and estimates relative number and type of trash source.	Santa Clara, San Mateo, Alameda Counties	See Protocol # 1, above	See Protocol # 1, above	• See Protocol # 1, above • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).
3	RTA	San Diego Trash Assessment Worksheets. A qualitative estimate of the presence of trash is determined and documented on the Trash Assessment Form. This is a qualitative assessment that should reflect a first impression of the site. There are five categories to describe the amount and extent of trash at each site. Trash type is also recorded.	County of San Diego MS4 Co-permittees	See Protocol # 1, above	See Protocol # 1, above	• See Protocol # 1, above • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).
4	RTA	Revolon Slough Trash Management and Reporting Plan. Collection of pieces/weight/volume from receiving water locations and visual screening of receiving water locations. Observed types of trash using 9 general categories: Plastic/Styrofoam, Landscape Materials, Toxic/Hazardous/Biohazardous Materials, Paper Products/Biodegradable, Aluminum/Metal, Glass, Household Items, Automotive, Agricultural Plastics/Trash, Other	Ventura County	See Protocol # 1, above	See Protocol # 1, above	• See Protocol # 1, above • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).
5	RTA	San Diego Creek Refuse Assessment Program - The RTA method. Workplan and Report. To provide a technical foundation for the trash assessment, this report identifies the persistent trash types, areas of recurring high trash accumulation, common sources, disposal methods, and entry routes of trash, and trends in trash volumes over time.	City of San Diego	• See Protocol # 1, above • Data standardization procedure: Survey areas were normalized by dividing total trash volumes by the survey area (recalculated as square feet). The resulting representative total trash volumes used in the report are expressed as cubic feet (ft^3) per square foot (ft^2).	See Protocol # 1, above	• See Protocol # 1, above • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
		(a) Goals: Identifying and characterizing persistent trash types and evaluating the recurring high-trash-accumulation sites; (b) Determining the most persistent sources, disposal methods, and entry routes for trash entering creeks; and (c) Evaluating trends in trash volumes over time. The report presents AMEC Foster Wheeler's technical evaluation of the City's 2009–2013 trash assessment data. (1) Results presented: Total trash volume by trash type (Food Packaging, Household Items, etc.) to identify the most abundant types of trash (Section 2.2); (2) Average trash volumes and mapping the geographic distribution of the sites to identify locations that accumulate large amounts of trash (Section 2.3); (3) Relationship between average trash volumes and median income ranges of the surrounding community (Section 2.4); (4) Total and average trash volumes among various land use categories to determine which land uses contain high volumes of trash (Section 2.5); (5) Presence and absence of trash within various land uses to identify the land uses with persistent trash accumulation (Section 2.6). Measured volumes for 12 trash categories. During Refuse Program assessments, City staff determined sources, disposal methods, and entry routes for each trash type by observing surrounding land uses, looking for nearby transient encampments, and evaluating additional evidence when available. Staff were instructed to choose sources, disposal methods, and entry routes from the following: Source: General Public, Business-Related, Transient, or School Disposal Method: Littering or Dumping Entry Route: Storm Drain, Upstream, Dumping, or Other Detailed definitions of sources, disposal methods, and entry routes are provided in Appendix C of the City's report. There are volumes of trash from the different sources, but it is not clear how volumes were measured.		• There was not rationale provided for why the surveyed sites were selected.		

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
6	dRTA	San Jose Trash Monitoring and Reporting Plan (December, 2016). Plan to monitor 6 hot spots, 1x/year, during dry weather. Data to be collected include weight and volume of trash removed, types of trash removed (8 categories for characterization), and estimate of proportion of trash from municipal separate storm sewer system (MS4) and non-MS4 sources. Includes qualitative (RTA-based) and quantitative methods. Provides list of typical pathways for common trash items and 8 categories for classifying trash. Protocol includes photo documentation.	City of San Jose	• See Protocol # 1, above • Qualitative sources and pathways methodology and data forms • Types of quantitative metrics used (weight, volume) • Quantitative assessments of trash originating from different sources/pathways • Trash characterization forms • Photo documentation protocols • QA/QC guidance	See Protocol # 1, above	• See Protocol # 1, above • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).
7	Other	Guadalupe River & Coyote Creek Trash Assessments. Yearly inspections of creeks within SCVWD property and easement have been conducted for several years. These inspections primarily look for issues related to flood hazards such as blockages or streambank erosion; however, large trash and debris accumulation points and large trash items are also recorded. Staff monitoring trash accumulation points via driving/walking. A Trimble YUMA device with ArcPad was used to record information on each trash accumulation point. This included GPS location, stream stationing, location description, most prevalent trash types, potential pathways/sources, and a cubic yard estimate. SCVWD experimented with Survey123 and developed a monitoring form with City of San Jose. They recorded some data for Coyote Creek on trash accumulation and illegal encampments.	SCVWD	• A rough estimate of volume per trash accumulation point is recorded during the monitoring event. The most prevalent trash types observed are also recorded, along with information on potential pathways/sources. • During follow-up cleanup events, the number of trash bags collected is converted to volume and recorded for each site. • At select sites, trash characterization is conducted and the number of pieces of each trash type is recorded. • Monitoring frequency: monitoring is conducted twice per year. • Survey results indicated that stream stationing is a good way to identify monitoring sites. Stationing is essentially the distance in linear feet upstream of a creek mouth (or confluence). The SCVWD stream stationing data layer (identified as Creek Route) is available at https://valleywater.maps.arcgis.com/home/gallery.html#c=organization&o=numviews&f=layers-layerfiles .	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts? • Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?	• Informs management decisions • Accounts for different stream and channel types, and considers temporal variability (e.g., to estimate baseline conditions and show change over time) and seasonality • Can assess trends over time • Assists in determining relative contributions from different pathways (i.e., wind, illegal dumping, illegal encampments, and MS4s). • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups).
8	Other	Annual coastal cleanup day data collection activities. Source: California Coastal Commission Coastal Cleanup Day Website: https://www.coastal.ca.gov/publiced/ccd/history.html) Website data includes item counts and percentages for different trash categories. The 2015 Annual Report mentions trash weight data; however, weights are not included in any tables. The 2015 report summarizes item counts from all Counties in CA.	The Watershed Project; Contra Costa and Alameda Counties	Types of data typically collected and reported by volunteer groups.	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts?	• Allows for comparison of trash levels between sites (understand the range of levels of impact) • Can assess trends over time • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups). • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
						direct discharge offset provisions (MRP Provision C.10.e).
9	Other	Hot Spot Assessments - Cleanups and Trash Hot Spot Cleanup Data Collection Form per San Francisco Bay Regional MRP. For creeks and shorelines	San Francisco Bay Area Permittees	• Use of Trash Hot Spots as Receiving Water Trash monitoring locations • Data forms with: o Five most relevant trash types. o Potential trash pathways/sources. o Volume of trash collected for bagged and unbagged trash (larger items). o Photo documentation procedure before and after cleanup activity.	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts? • Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)? • Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	• Informs management decisions • Allows for comparison of trash levels between sites (understand the range of levels of impact) • Assists in determining relative contributions from different pathways (i.e., wind, illegal dumping, illegal encampments, and MS4s). • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups). • Leverages and exhibits consistency with existing monitoring efforts and other water quality monitoring programs, including direct discharge offset provisions (MRP Provision C.10.e).
10	Other	SCVURPPP Photograph Documentation Protocol for Creek and Shoreline Trash Hot Spots protocol - Documents trash conditions before and after the clean-up event of the entire hot spot with a minimum of one photo per 50 ft. of hot spot length.	SCVURPPP	Photo documentation procedure (per MRP). Protocol has specific instructions on the file naming conventions for before and after cleanup photos.	See Protocol # 9, above.	See Protocol # 9, above
11	Other	Trash Boom - floatation structures with suspended curtains used to collect floating trash. Information summarized comes from the Tracking California's Trash (TCT) project literature review (EOA Inc. and 5 Gyres, 2014). The TCT literature review summarized 5 studies. One study was local, City of Oakland, 2008. Oakland slough, installed in 1999. Measured volume of trash removed. Also communication with Lake Merritt Institute Director about factors that affect boom performance, e.g., easily overtopped by high flows, leak at the sides where they are attached, need to be replaced due to breakage. Content discussed included trash boom capture rates, that trash booms only capture floatable material, and therefore do not represent the complete range of items found in urban runoff. In the Queens, NY study, boom effectiveness was determined by measuring the quantities of floatable materials present in the water and on the shorelines before and after boom installations. The Los Angeles County study found that approximately 90% of trash harvested from the first storm is vegetation. The remaining 10% is mostly Styrofoam™ and plastics.	City of Oakland; County of Los Angeles; Queens, NY; Albuquerque, NM; Melbourne, Australia, City of Palo Alto, Santa Clara Valley Water District	• Factors that affect boom performance, which could also affect monitoring data collection. • Metrics used to measure trash accumulated by booms.	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts? • Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)? • Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	• Informs management decisions • Allows for comparison of trash levels between sites (understand the range of levels of impact) • Assists in determining relative contributions from different pathways (i.e., wind, illegal dumping, illegal encampments, and MS4s). • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups).
12	Other	Los Angeles Trash Monitoring and Reporting Plan (Advtech Environmental, Inc., 2015).	City of Los Angeles	• Site selection criteria and types of data used (e.g., number of outfalls upstream of the monitoring location). • Photo documentation.	Ultimately, this protocol was not used to develop the Monitoring Program Plan.	Ultimately, this protocol was not used to develop the Monitoring Program Plan. Using a small net to remove trash from the water column is not considered to be an appropriate

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
		The program focuses on monitoring trapezoidal channels and monitoring natural channels has a lower priority. The data collected are to be measured in two ways: (1) Abundance Metric: Total Abundance Number (number of items observed at monitoring sight)/ site area (ft2) (2) Mass Loading: sum of Abundance metrics multiplied by Category Weight = weight of individual trash item identified in the Trash Library (Appendix D of City report). Protocols are restricted to dry weather. This is defined as sampling events occurring a minimum of 72 hours after a rain event. Daylight hours only. Trash categories measured: • Plastic-bags, bottles, cups, six-pack rings, bottle caps • Paper-cardboard, newspaper, letter paper • Metal-cans, metal pipe, rebar • Wood-lumber, pallets • Glass-bottles, windows • Biohazard-Diapers, pet waste, dead animals, syringes • Miscellaneous-appliances, furniture, tires, shopping carts, cigarette butts Only source/pathway info appears to be noting if there are illegal encampments or evidence of illegal dumping observed-on data sheet. <u>Monitoring methodology:</u> Primary method. In-River Observation (IRO). Surveyors located within a fixed 300-foot demarcation zone, photo document observable trash, recorded type, quantities, approximate locations, conducted stream-flow velocity measurements, and suspended trash monitoring utilizing a net placed in the river. A more detailed survey of debris could be characterized and recorded using IRO. Secondary, or alternative method. High Elevation Point Observation (HEPO). Surveyors position themselves on a bridge, located within a fixed 300-foot demarcation zone and photo document all observable trash impacts in the river and on the river banks, and record type, quantities, and approximate locations. Continuous Monitoring (CM) method using video cameras (pilot study conducted by TRC Solutions, Inc., 2016). CM protocol was eliminated. The wide camera angle installed during the pilot study to capture the full 300-feet length of the survey area limited the detail needed to utilize the video for monitoring purposes. Should CM be utilized, a camera with greater zoom capability and higher clarity optics need to be employed. <u>Monitoring Frequency</u>. Two TMRP monitoring events scheduled for the calendar year, where the first event of the scheduled year starts after Memorial Day (representative of the Wet season), and the second event after July 4 holiday (representative of the Dry season),		• Field equipment checklist. • Channel cross section delineation. • Appropriateness of the protocols for monitoring trapezoidal and natural channels.		method for addressing the Monitoring Program Questions/Goals at this time.

Protocol No.	Source[1]	Protocol Name/Description	Agency/ Organization	Elements Considered or Used to Develop Receiving Water Trash Monitoring Protocols	What Receiving Water Monitoring Questions May Be Addressed?	What Monitoring Program Goals May Be Addressed?
		Resources: The estimated total field time could range from 25 to 45 minutes depending on the location.				
13	Other	NOAA Marine Debris Shoreline Survey Field Guide For Standing-stock studies. Accumulation studies on shorelines, e.g., beach cleanup locations (# of items per unit area, per unit time). Accumulation studies can also provide information about debris type and weight. These surveys cannot be used to measure the density of debris on the shoreline because removal of debris biases the amount of debris present during subsequent surveys. What is measured (see Table 1 of the document): Debris deposition rate (# of items/ unit area/unit time), debris material types, debris weight. Standing-stock studies provide information on the amount and types of debris on the shoreline. Debris within discrete transects at the shoreline site is tallied during standing stock surveys. This is a quick assessment of the total load of debris and is used to determine the density (# of items per unit area) of debris present. Debris density reflects the long-term balance between debris inputs and removal and is important to understanding the overall impact of debris. What is measured (per Table 1 of the document): Debris density (# items/ unit area), debris material types. This is done for 20% of the 100m shoreline assessment area using transects. Debris is not removed from the shoreline. Minimum debris size counted is 2.5 cm (1 inch-bottle cap size)	NOAA	• Site selection criteria for shorelines. • List of equipment needed to do the monitoring. • Guidance on how to delineate the back of the shoreline area (e.g., change in substrate material). • Good shoreline characteristics form. Provide info such as tidal range, tidal distance (see pg. 8 of the document) • Guidance on how to walk the shoreline within the assessment area to get complete visual assessment. • Guidance on how to randomly select transects.	• Is trash present in receiving water(s) (*defined as creeks, channels, lakes, lagoons, wetlands, and the Bay shoreline*) at levels that may cause adverse water quality impacts? • Is trash (if present) being transported from one receiving water to another, at levels that may cause adverse water quality impacts?	• Informs management decisions • Can assess trends over time • Allows for comparison of trash levels between sites (understand the range of levels of impact) • Cost-effective, efficient and feasible (e.g., safe, access to sample locations, can be implemented by volunteer monitoring groups).

Notes:

[1] Source: RTA = Original RTA or primarily based on RTA
dRTA = Some elements derived from RTA
Other = not based on the RTA

Attachment 3
Stakeholder Meeting Summaries

B A S M A A

Receiving Water Monitoring Program
Stakeholder Meeting Summary
Tuesday, October 25, 2016

Attendees
See Attachment.

Project Background
Beth Baldwin reviewed the MRP requirements, contract award, management questions, conceptual sources and pathways, project tasks, and timelines. She reiterated that this meeting is an opportunity for stakeholders to learn about the project and provide input. This first meeting will review the program goals. Overall there will be 3 to 4 opportunities for stakeholders to provide input at key points in the project.

Receiving Water Definition
The Project Team should revisit the receiving water definition and include Bay shoreline, lagoons, and reservoirs. While the Team should consider all types of receiving waters, the initial focus should be on what is most feasible now. The question regarding transport from one receiving water to another does not just mean the Bay, but also includes transport from a tributary to the main stem of a receiving water.

Priorities
In terms of answering the monitoring questions, consider optimization rather than prioritization. The Program should start with full consideration of all monitoring questions, but focus on simpler, more cost effective tools, and note where these tools are available. Don't overlook the potential for more complicated tools later on as part of a phased process. Make a list of questions and needs not being addressed immediately, for future grant funding. The cost-effective/feasible goal should include the feasibility of having public participation.

Monitoring Program Goals
The Program Goals are broad, especially the "Inform Management Decisions" goal. There are several interesting sub questions such as effectiveness of on-land actions, effectiveness of full capture systems. Additionally if trash is present in a receiving water, is it being assimilated there or being transported elsewhere? How comprehensive is the baseline monitoring program going to be? Will it be affordable?

Compliance with MRP
Will the monitoring program be used to evaluate if Permittees are in compliance with the MRP? The Regional Water Board indicated that receiving water monitoring is not a driver for permit compliance in this permit term. During this period, tools will be built but not used this permit term to assess compliance. Also, do the management questions consider the questions in the Trash Amendments?

Trash Monitoring Survey

It would be advantageous to align with existing volunteer data collection efforts, but the Team should be careful not to scare them by asking for them to do too much. It is also important to coordinate with groups that do cleanups but are not collecting data. (Allison Chan can provide a list of groups to contact.) It would be helpful to address what all the volunteer groups are doing and coordinate with them to know when the cleanups are occurring, as trash removal efforts could affect monitoring results. The Regional Water Board's preference for data collection is volume measurements, rather than weight measurements. It was also suggested that it could be useful to tap into Southern California efforts, and perhaps contact municipalities through CASQA to see if they are doing something unique that is worth considering for our effort. Stakeholders would like transparency on what monitoring strategies are considered.

Monitoring Tools

The Monitoring Program will need to address how the data is managed and the reproducibility of assessment. The PMT could consider a combination of field versus office analysis (i.e., field photos assessed later in office). There is a need to allow for public participation in the program implementation and consider challenges with managing public generated data. Incorporating hotspot monitoring can provide useful data as lower loads at hotspots might indicate improvements, and may help distinguish sources. Coordination with Coastal Cleanup Day (data cards, work to create guidance for volunteers to take advantage of the bag term trends, reach out to coastal commission) could be a useful tool. Local groups do cleanups but may not be collecting data, as was discussed above. Consider utilize Tracking California's Trash (TCT) program data collection methods. Consider whether monitoring efforts should be weighted based on impairments.

B A S M A A

Receiving Water Monitoring Program
Stakeholder Meeting Summary
Tuesday, January 31, 2017

Attendees

See Attachment 1

Task 2 Review & Evaluation of Potential Tools

303(d) listed water bodies

Question from PMT member about 303(d) listed water bodies and how it is being used in the development of the program.

> Response: it is being noted as part of the characteristics of the consideration process, but it is not a limitation on where sampling will occur.

Trash Volume

Dale emphasized that trash volume must be collected otherwise the information will be useless to the Water Board as all their metrics are in volume.

Survey Results

Luisa expressed concern that the survey results were not comprehensive. Too small of a sample size to draw any conclusions and most of the respondents were volunteer, not permittees.

> Response: The small sample set was one of the reasons that the literature survey was extensive to cover the available protocols that were not identified by the respondents.

Dale asked why all the MRP jurisdictions did not complete the survey.

> Response: Hot spot assessments were specifically excluded since that is not receiving water monitoring, and all the jurisdictions are using the same protocol, which is known to the project team. Also, on-land clean ups were excluded. These are the 2 types of monitoring permittees are currently conducting.

Remote Sensing and New Technology

Both Dale and Luisa expressed interest in understanding the newer technologies available to monitor trash in receiving waters. Luisa noted that not evaluating new technology is an oversight and these technologies cannot be excluded from evaluation purely on cost. Dale has great hopes that new technology will make the monitoring easier and would like the factors considered in the short term even if they are not part of the pilot phase. As an example Dale suggested it should be technically feasible to

place a camera at the Oakland Embarcadero and do continuous monitoring of trash in the harbor. It was noted that Los Angeles did this type of monitoring and found it not useful to identify trends and address management questions. It was mentioned that videos were taken from a boat in Alviso Slough of all the trash along the banks.

Methodologies

After heavy flows creeks look good but the shorelines contain a lot of trash. Monitoring Program should respond to different seasonal situations and consider antecedent flow conditions. Need to make sure that the methods allow the permittees to meet the MRP requirements and addresses sources of trash as required. Just monitoring shorelines will not address trash sources.

Methodology needs to be responsive to direct discharges. San Jose Direct Discharge Method should be elevated in rank to a "1", SCVURPPPP is following this protocol.

Methods not receiving a top rank (1) will not be evaluated in the first phase. Dale wanted to know how the other methods would be evaluated. He also noted that he is pretty sure that the Water Board wants a method that strains water or visual (camera) sensing of water surface be included.

Concern was expressed the that the list of 13 methods, with the exception of trash boom, were variations of the same method, the RTA and assess though a process of "vegetative straining" (trash that gets caught up in the vegetation along water bodies).

> Response: The survey and literature review are demonstrating that there are not a lot of new ideas for receiving water trash monitoring. It was suggested that the RTA methods would help to identify where remote sensing could be conducted.

Task 3 Monitoring Tool Development and Protocol Development

Most of the protocols identified in the literature review are based on the RTA. Dale noted some of the elements he considered weaknesses in the RTA:

- No specification of the Creekside environment where the method can be used.
- No specification of the antecedent flow condition for the method to be applied.
- Need to document recent clean up events.

> Response: It is expected that that the protocol for this project would address these concerns, e.g., limiting the application of the method to certain types of conditions and documenting the type of vegetation present.

Dale does not think that the RTA is a good method, if they did, then it would have been in the permit. Permittees noted that the Board did try to do this but the permittees objected. He would like to see volume assessment rather than a count of trash items. Counts can be use if they are needed by permittees, but volume must be assessed. Counting is a challenge: good for cigarette butts, but not so good for clothing or Styrofoam pieces from a cup.

Direct discharge needs to be a separate method.

Dale noted that merely seeing trash in the creek is a major water quality impact. The trash doesn't need to hurt anyone.

Response: REC-2 beneficial use was the major impact justifying the 303 (d) listing. The REC-1 beneficial use (aesthetics) was not a factor in the listing. This difference has a major effect on the resolution of the monitoring.

It was noted that we need to separate the discussion of when to monitor (timing) and where to monitor (location) from the discussion of the protocols because they are different evaluations. One protocol could be used that specified various timing and location factors that would allow various management questions to be assessed.

Dale noted we are in the era of the "trash we can see". "If you have to struggle to find it you are doing good." Qualitative assessments could be used quantitatively, for instance with on-land assessments and we can show changes over time. But it is a question of resolution – we cannot show a 2% change, but can show 25% change.

Response: One of the goals of the pilot would be help establish this relationship for receiving water assessments. As yet this has not been demonstrated.

Dale would like to include in the data collection: the type and density of vegetation, and recent flow history of the creek (visual assessment of high water marks, rainfall, stream gauges). There was a discussion about whether this is information to be collected associated with the monitoring or whether these should be monitoring design limitation, e.g., don't monitor creeks after a certain size event. If a limitation, it makes it much harder to get sufficient numbers of events.

Dale said he was coming to the realization that some type of trawl monitoring in the Bay after storm events should be performed. It was suggested we think about this project not as answering every question now, we need to collect data over the next few years, after which we will be able to ask better questions and be able to design monitoring and to answer those questions

Need some way to keep track of the information. Need to consider how everyone who is doing their own thing can contribute their information.

Luisa asked whether we care about the creeks or the Bay. If the Bay, do we need to do monitoring in the dry season at all? Would we need to monitor the upper watershed or do RTA dry weather monitoring? It was noted that wet weather monitoring really means during the rainy season. No programs send field crews into creeks during rain events. It is not safe. Dale doesn't think that dry season monitoring matters for creeks. If there is no rain, there is nothing to move it. Shoreline monitoring might be needed during the dry season because there are other factors moving trash. Dale noted he wants some type of near shore water column monitoring immediately after the storms, but this doesn't have to be part of the pilot phase. Need to consider permits, etc., that are necessary to do trawling.

Monitoring locations

We discussed the current set of locations used by the RMC and hotspots. The RMC sites, used for bioassessments are in wadable creeks. Comments on this approach included:

- These sites may miss near shore depositional areas.
- These sites may miss deeper, higher flow creeks due the wadable limitation.
- These sites were selected based on a probabilistic evaluation, which is critical to understanding POCs in the watersheds – allows the view of the whole system, not just the worst.

- These can be used to establish context for the trash assessments.

The hotspot sites are based on permittee observation of trashy areas.

- These are the worst sites.
- These sites tend to be in the lower watershed.

Dale noted he is most interested in seeing progress at the hotspots. If you assess the better sites, you won't see improvements. Question: Has anyone aggregated the data from the hotspot program region wide?

Response: Some countywide programs have looked at it but haven't seen trends.

B A S M A A

Receiving Water Monitoring Program
Stakeholder Meeting Summary

Monday, June 12, 2017
10:00 – 12:30pm
EOA, Inc.
1410 Jackson Street, Oakland

1. Introductions

Participants (See Attachment 1)

2. Summarizing progress made since last Stakeholder Meeting

Chris Sommers (EOA) provided an overview of the State Water Board/Ocean Protection Council Workshop that was held in May to begin outlining the three-year study to test receiving water trash monitoring methods. Chris indicated that this effort should be coordinated with BASMAA's effort to develop and implement a Monitoring Program Plan (Plan).

In May 2017, the PMT sent the Draft BASMAA Receiving Water Trash Plan to technical experts for peer review. The peer review team consisted of Shelly Moore (SCCWRP), Sherri Lippiatt (NOAA) and Aroon Melwani (AMS). The peer reviewers provided several useful comments/recommendations associated with the monitoring design, protocols, assessment area definition and quality assurance procedures.

General comments from the peer reviewers included:

- Development and inclusion of scientific monitoring questions to provide more guidance on how Permittees can better link monitoring designs to management questions; and
- Include an approach to manage the data and disseminate results to the public.

Specific comments from peer reviewers included:

- Support on decision to focus on deposited trash;
- The acceptable use of the existing RMC sample frame for trash;
- Consideration of quantifying trash volumes at probabilistic sites as well as target sites;
- Better explanation of how to relate results from targeted sites will be used with probabilistic data;
- Better description on how volunteers can be utilized;
- Identification of trash types to assess transport;
- Estimate percent cover of trash for assessment area;
- Define width to include contour of the stream bank/channel;
- Improvements in descriptions of site evaluation procedures; and
- Additional specificity on QA/QC procedures and training requirements.

3. Review of Project Schedule

Chris presented the following project schedule:

- Stakeholder Comments (6/13/17)
- Final Comments by PMT members (6/20/17)

- BASMAA Board Approval (6/29/2017)
- Submittal to Water Board (7/1/2017)
- Begin Implementation (10/1/2017)

4. Presentation of Monitoring Program Plan

A summary of each section of the Plan was presented to the stakeholder group. Several comments were raised during the presentation, including the following:

- Some stakeholders were concerned about monitoring sites that contain illegal encampments. These sites may require additional staffing that are trained to deal with issues associated with illegal camps, including the posting for removal of materials and hazard waste handling. Due to these circumstances, removal of the trash associated with illegal encampments during a monitoring event may not always be possible. The group agreed that guidance should be provided in the Plan to document what will be done in these circumstances.
- Some stakeholders raised questions regarding the Plan's recommendation to monitor a total of 30 unique probabilistic sites within each county during the pilot-testing phase. Chris explained that 30 sites were selected as adequate number to provide an acceptable confidence level in estimating trash condition for each county during the pilot-testing phase. Chris reminded the group that the PMT had previously agreed on monitoring 30 probabilistic sites for each of the major county programs. Paul Ledesma (Save the Bay) reminded the group that having enough sites to confidently evaluate trash conditions and form a baseline was an important goal of the Plan.
- Stakeholders requested that the PMT reevaluate the pathway categories and the ability of field staff to identify trash associated with each. The group generally believed it would be highly difficult, if not impossible to identify each pathway as written in the plan, with confidence. This is especially true for the stormwater pathway. The PMT agreed to reevaluate the pathway definitions.
- Water Board staff indicated the importance of documenting changes in vegetative condition and antecedent storm conditions for each monitoring event during the pilot-testing phase. Chris indicated that a vegetative condition assessment is part of the protocol and antecedent conditions prior to storm events can be obtained and analyzed for data interpretation.
- Although not present at the meeting, Chris shared verbal comments provided by Luisa Valliela (USEPA). She understood that for this pilot-testing phase having field staff observe or measure trash was necessary, but re-iterated the need to further evaluate trash monitoring protocols that are less resource intensive (e.g., remote sensing or photography) for future trash monitoring.

5. Next Steps

- June 13th – Stakeholder Comments due
- June 16th - EOA to develop Revised Plan based on Stakeholder comments and develop draft response to comments table
- Tuesday, June 20th – PMT to review Revised Plan and provide comments to EOA by COB
- Thursday, June 22nd (following BASMAA Board meeting) – PMT to meet at EOA to discuss final PMT and stakeholder comments, and the Revised Plan
- Tuesday, June 27th – EOA to provide Final (Draft) Plan to Geoff Brosseau for BASMAA Board approval
- By July 1, 2017 – Geoff to get approval by the BASMAA Board on the Final (Draft) Plan and submit to Water Board for All Permittees with transmittal letter indicating a timeline for review and approval by the Water Board EO.

Name	Agency	Email	25-Oct-16	31-Jan-17	12-Jun-17
Jim Scanlin	ACCWP	Jims@acpwa.org	Present	Present	Phone
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Name	Agency	Email	25-Oct-16	31-Jan-17	12-Jun-17
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Doug Scott	VSFCD				
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Attachment 4

Comparison between Monitoring Questions in MRP 2.0 and the Statewide Trash Amendments

Municipal Regional Permit versus Statewide Trash Amendment Monitoring Questions

MRP 2.0 Monitoring Questions	Trash Amendment Monitoring Questions
Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving water(s)?	Has the amount of trash discharged from the MS4 decreased from the previous year? If so, by how much? If not, explain why.
	Has the amount of trash in the MS4's receiving water(s) decreased from the previous year? If so, by how much? If not, explain why.
	What is the effectiveness of the total combination of treatment controls, institutional controls, and/or multi-benefit projects employed by the MS4 permittee?
Is trash present in receiving water(s), including transport from one receiving water to another at levels that may cause adverse water quality impacts?	Has the amount of trash in the MS4's receiving water(s) decreased from the previous year? If so, by how much? If not, explain why.
Are trash discharges from a Permittee's jurisdiction causing or contributing to adverse trash impacts in receiving water(s)?	Has the amount of trash discharged from the MS4 decreased from the previous year? If so, by how much? If not, explain why.
Are there sources outside of a Permittee's jurisdiction that are causing or contributing to adverse trash impacts in receiving water(s)?	Has the amount of trash discharged from the MS4 decreased from the previous year? If so, by how much? If not, explain why.
Not applicable	What type of and how many treatment controls, institutional controls, and/or multi-benefit projects have been used and in what locations?
Not applicable	How many full capture systems have been installed (if any), in what locations have they been installed, and what is the individual and cumulative area served by them?

Attachment 5

Summary of Watershed Area Characteristics of Probabilistic Monitoring Sites

ATTACHMENT 5
WATERSHED CHARACTERISTICS FOR PROBABILISTIC MONITORING SITES

A summary of watershed characteristics that are potentially important for evaluating trash loading and transport to Trash Monitoring Sites was developed for all probabilistic sites that have been sampled by the RMC over a five-year period (2012-2016), including the following information (if available) for the watershed area draining to each site:

- RMC site Station ID;
- Watershed size (acres);
- Watershed Percent Impervious;
- Watershed Percent Urbanization is based on 2015 US Census Bureau information for Urbanized areas;
- Watershed Category. Urban or Non-Urban. Urban watersheds are defined as having at least one third of its watershed drainage area with an Urbanized Area, as defined by 2015 US Census Bureau data;
- USGS National Hydrography Data Set Stream Category (Perennial Stream, Intermittent Stream, Canal/Ditch). Perennial streams must have water all year long, except in periods of extreme drought. Intermittent streams have water most of the year and usually dry up in the summer. A canal/ditch is an artificial (engineered) open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft;
- All RMC sites that were sampled were classified for flow status based on visual observations performed during the dry season;
- Stream Order (Data Source: Bay Area Aquatic Resource Inventory [BAARI]). Stream order, delineated by the Strahler method designates a hierarchy of streams from the source (or headwaters) downstream. The headwaters are the first order and downstream segments are defined at confluences. At a confluence, if the two streams are not of the same order, then the highest numbered order is maintained on the downstream segment. At a confluence of two streams with the same order, the downstream segment gets the next highest numbered order;
- On-Land Trash Generation Rate Categories (Very High - Low) and Numerical Trash Generation Rate. On-land trash generation categories correspond to the following trash generation rates as described in MRP provision C.10.a:
    - Low = less than 5 gal/acre/yr (mid-point – 2.5);
    - Moderate = 5-10 gal/acre/yr (mid-point – 7.5);
    - High = 10-50 gal/acre/year (mid-point – 30); and
    - Very High = greater than 50 gal/acre/year (mid-point – 100).

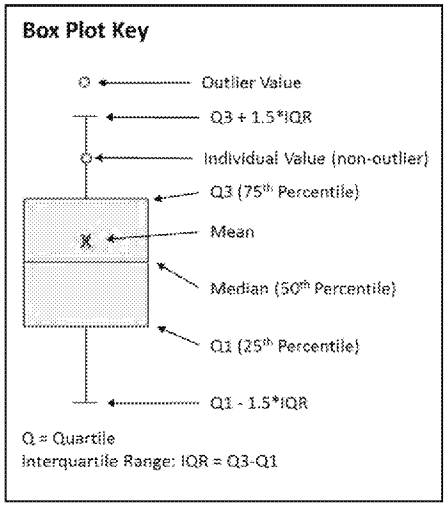
  For each category, the midpoint (average) of the trash generation rate for each category (see below) was applied to watershed land areas depicted in Permittee Baseline Trash Generation Maps to calculate an estimated annual volume of trash (gallons/year)

generated via the MS4s upstream of each Trash Receiving Water Monitoring point derived via the RMC sample frame.

- Channel Alteration Score. The degree of channel alteration based on visual observation, per the SWAMP Standard Operating Procedure for bioassessment of wadeable streams. Channel alteration is divided into four condition categories that include narrative descriptions associated with a scoring range (0 – 20) as follows: Poor (0-5), Marginal (6-10), Suboptimal (11-15) and Optimal (16-20); and
- CRAM indices. These data are available for Santa Clara and San Mateo Counties only and include data collected prior to 2016. The California Rapid Assessment Method (CRAM) for wetlands has a scoring system for various attributes of riverine wetlands including Buffer and Landscape (Land), Hydrology (Hydro), Physical Structure (Phys), and Biotic Structure (Biotic). Land includes metrics of stream corridor continuity, a natural buffer adjacent to the assessment area. Hydro includes water source (e.g., groundwater, irrigation runoff), channel stability, and hydrologic connectivity. Phys includes structural patch richness (i.e., the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species), and topographic complexity. Biotic includes a plant community metric, horizontal interspersion (the variety and interspersion of plant zones in the assessment area), vertical biotic structure (assesses the degree of overlap among plant layers). Higher attribute scores indicate better conditions.

Summary statistics were calculated for some of the RMC sampled site characteristics, as discussed below. The summary statistics provide a synopsis of the attributes of the various watershed characteristics that could be important for trash loading and transport at the Trash Monitoring Sites. An *a posteriori* evaluation of the trash monitoring data will be performed to evaluate which characteristics are more important. For example, upon analyzing the monitoring data, the degree of channel alteration could be shown to a primary factor that affects downstream transport of trash.

Summary statistics include box and whisker plots (box plots). Minimum and maximum concentration values are displayed as 'x's; first, second, and third quartiles are displayed by lines bordering and transecting the colored boxes; the mean is displayed as a black diamond; and error bars, representing 1.5 of the interquartile range, or difference between the first and third quartile, are displayed above and below the maximum and minimum values, respectively. Open circles outside the error bars represent the data that are considered "far outside" values. A box plot key is shown to the right.



Watershed Size (Area)

Figure A5-1 shows box and whisker plots for watershed area, with and without outliers. Summary statistics are provided with the plot that includes outliers. Watershed drainage area could affect trash loading and transport in receiving waters. There is a broad range of watershed drainage areas for the RMC sampled sites. Watershed drainage areas range from 43 to 417,000

acres and the average drainage area is 20,296 acres. An *a posteriori* regression could be developed to show the relationship trash monitoring data (e.g., qualitative Trash Condition site score) and watershed drainage area to evaluate if drainage area size is an important factor that affects trash in receiving waters.

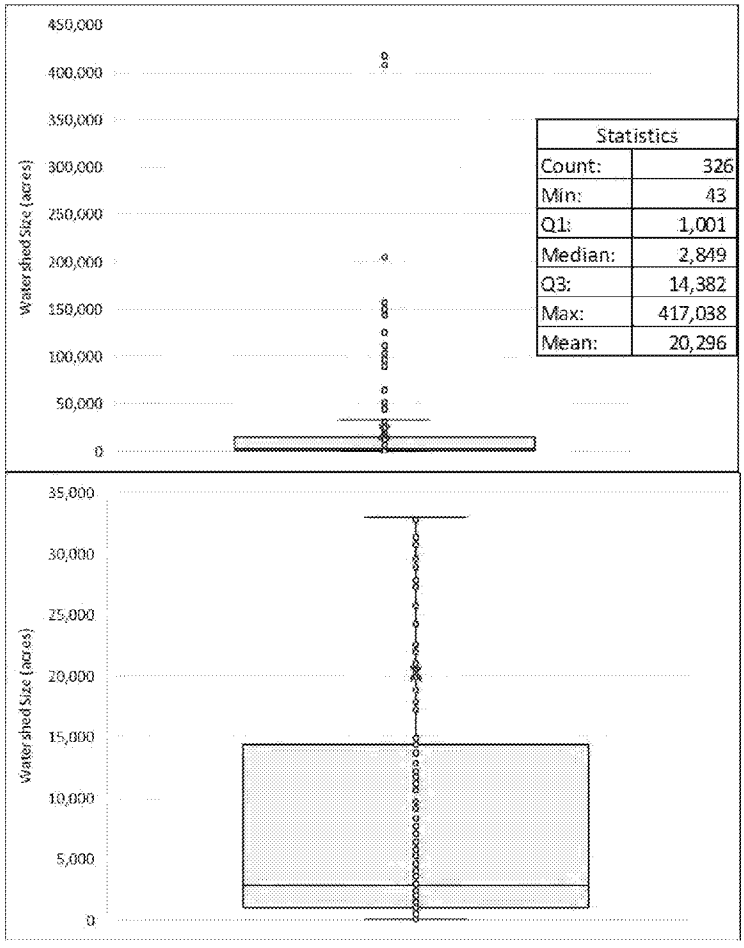


Figure A5-1. RMC Sampled Sites Watershed Area (with outliers, top graph; without outliers, bottom graph)

Percent Watershed in Urban Area

Figure A5-2 shows a histogram of the percentage of each RMC sampled site watershed that is within an urban area, as defined by 2015 US Census Bureau data. Fourteen percent of the watersheds have no urban land use and 15 percent of the watersheds are completely urban. **Figure A5-3** is a boxplot for the percentage of urban watersheds. Urban watersheds (i.e., RMC sampled urban sites) are defined as having more than a third of its drainage area in an urbanized area. Only RMC-derived sites in urban watersheds will be used as Trash Monitoring Sites. This is because the monitoring program will focus on urban sites, where the majority of trash is expected to be generated, as opposed to non-urban sites. An *a posteriori* regression could be developed to show the relationship trash monitoring data (e.g., qualitative Trash Condition site

score) and extent of urbanization to evaluate if this characteristic is a factor that affects trash in receiving waters.

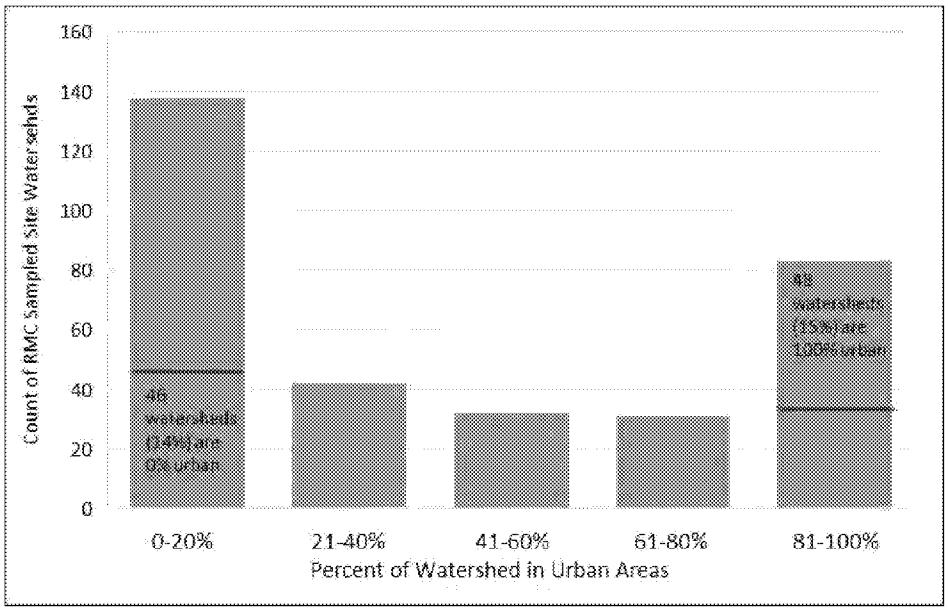


Figure A5-2. Histogram-Percent of RMC Samples Site Watersheds in Urban Areas

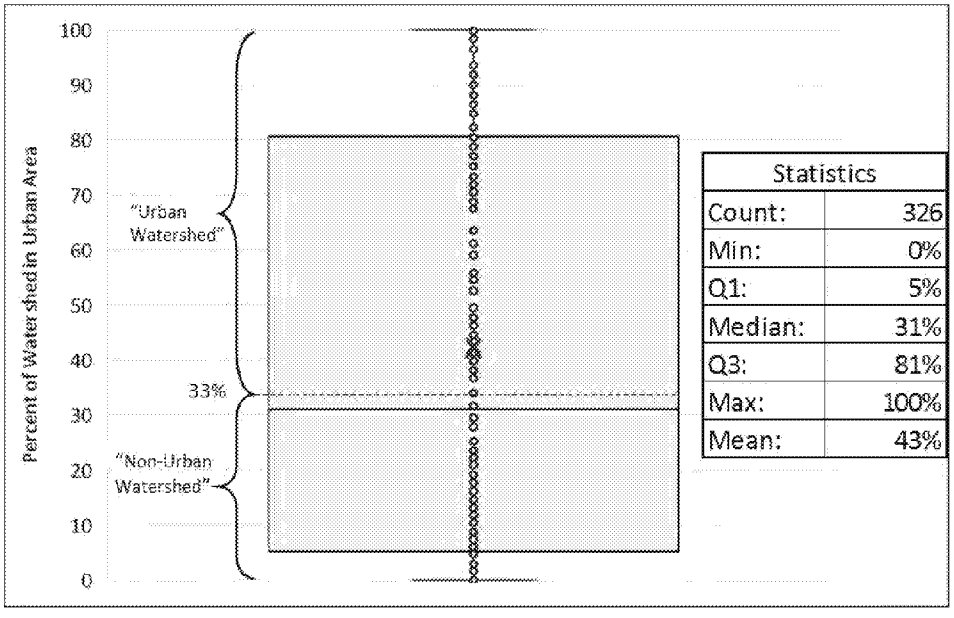


Figure A5-3. Boxplot-Percent of RMC Samples Site Watersheds in Urban Areas

On-Land Trash Generation Rate

The on-land annual trash generation rates for the RMC sampled watershed areas are shown in the cumulative frequency distribution plot in **Figure A5-4**. These data show that the trash generation

is primarily a function of the watershed area (**Figure A5-5**). Note that the red lines shown on these figures are arbitrary breakpoints for illustrative purposes only. **Figure s A5-6** and **A5-7** show the cumulative frequency distribution and boxplots for the numerical trash generation rate normalized by watershed area. The median normalized trash generation is 3 (including outliers), which corresponds to a low trash generating area (i.e., "A" visual assessment score). An *a posteriori* regression could be developed to show the relationship trash monitoring data (e.g., qualitative Trash Condition site score) and the on-land trash generation rate to evaluate if this characteristic is a factor that affects trash in receiving waters.

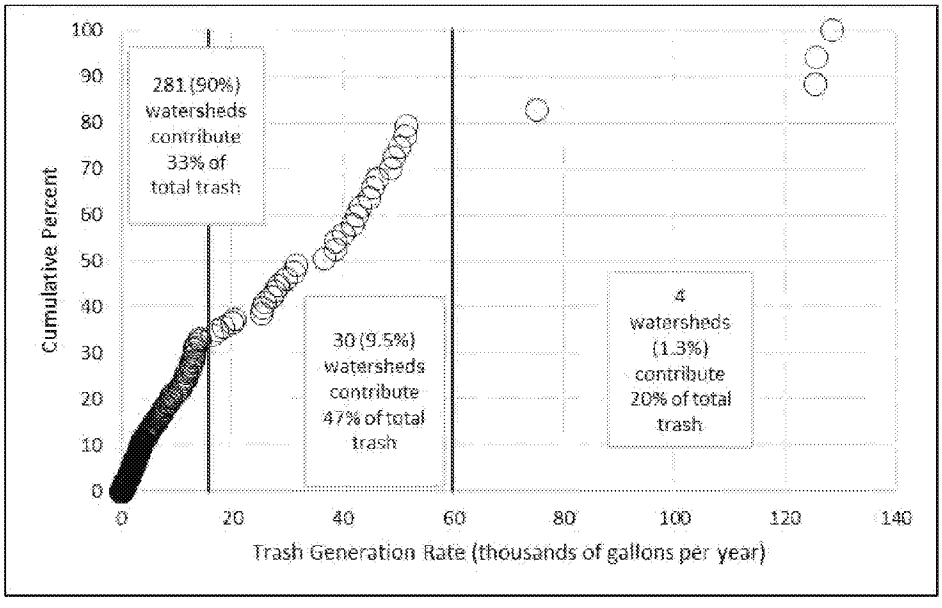


Figure A5-4. RMC Sampled Site Trash Generation Rate

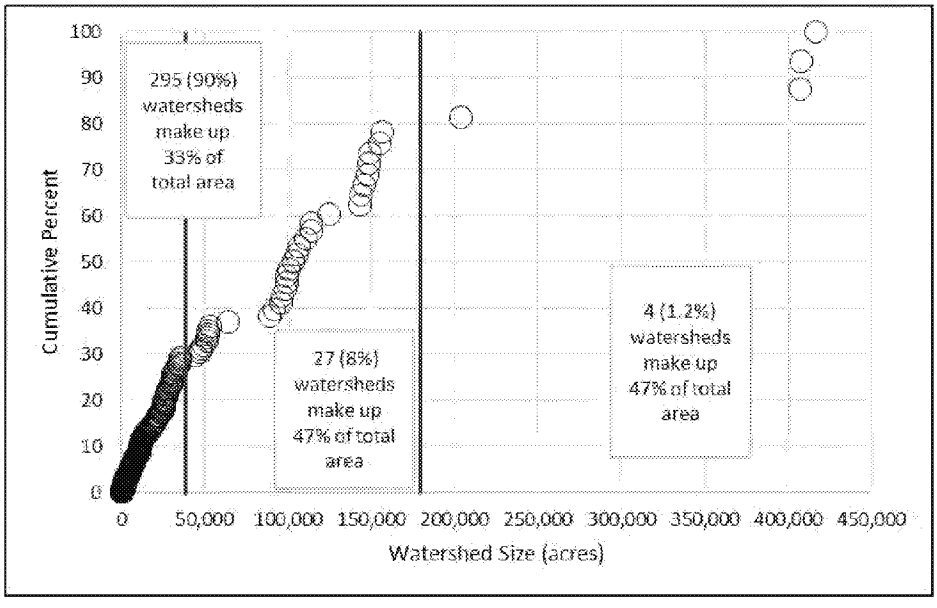


Figure A5-5. RMC Sampled Site Watershed Area

Figure A5-6. Cumulative Frequency Distribution of Trash Generation Rate Normalized by Watershed Area

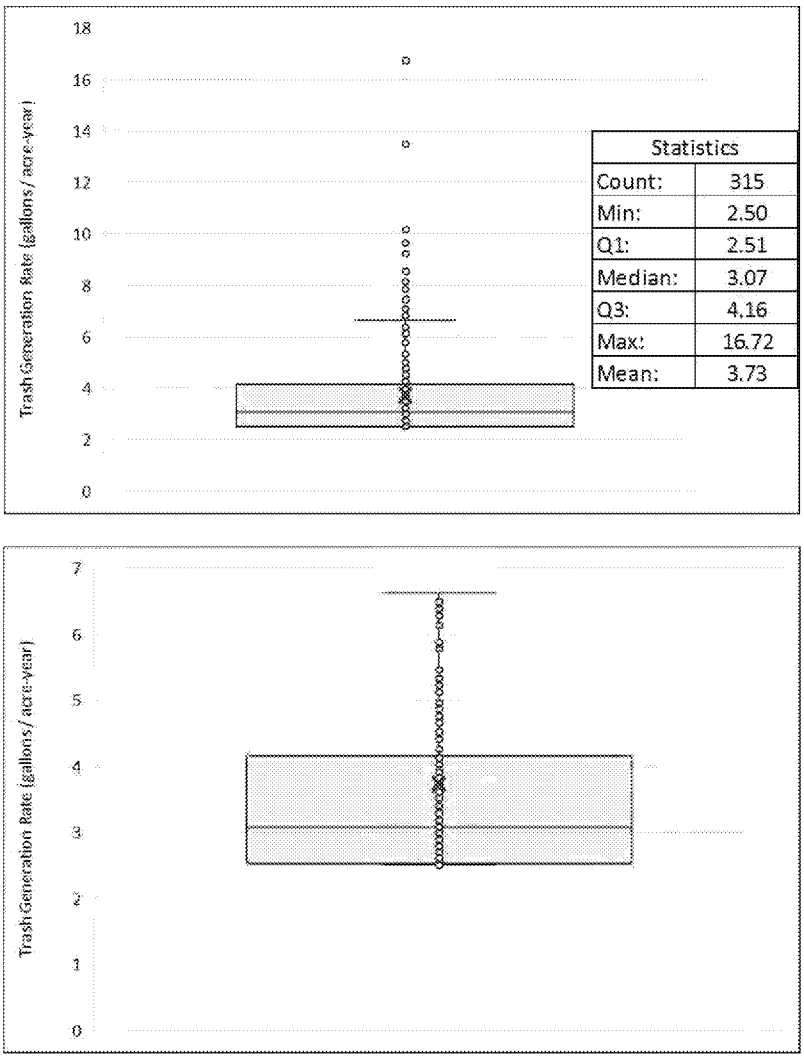


Figure A5-7. Boxplot for Numerical Trash Generation Rate Normalized by Watershed Area (with outliers, top graph; without outlies, bottom graph)

Stream Order

A histogram and box plot of stream order for the RMC samples sites is provided in **Figures A5-8** and **A5-9**, respectively.

First through third order streams are headwater streams (waterways in the upper reaches of the watershed). Streams classified as fourth through sixth order are medium streams while anything larger (up to 12th order) is considered a river. Medium and large rivers are usually less steep and flow slower, however, they tend to have larger volumes of runoff and debris resulting from downstream transport from the smaller waterways flowing into them. The median stream order for the RMC sampled sites is 5, which is a medium-sized stream. An *a posteriori* regression could be developed to show the relationship trash monitoring data (e.g., qualitative Trash Condition site score) and stream order to evaluate if this characteristic is a factor that affects trash in receiving waters.

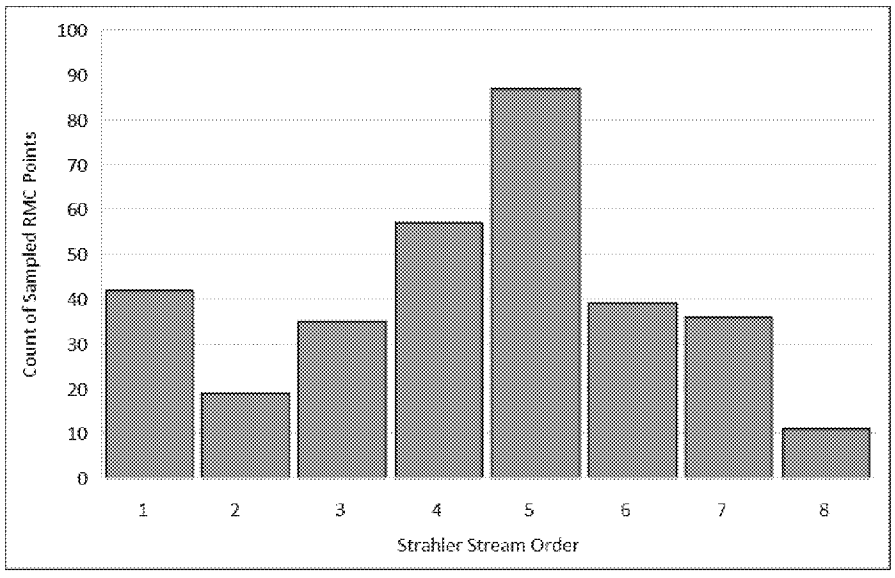


Figure A5-8. Histogram for RMC Sampled Sites Stream Order

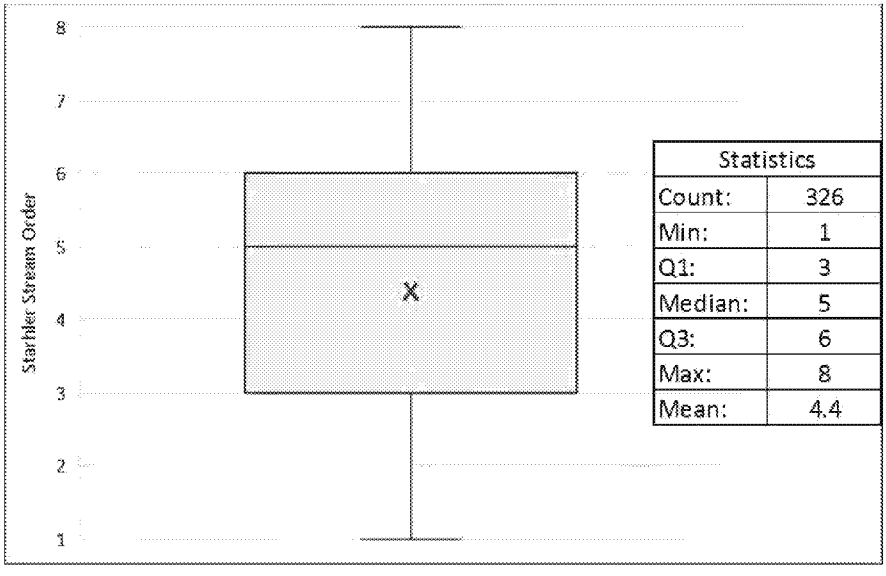


Figure A5-9. Boxplot for RMC Sampled Sites Stream Order

SWAMP Channel Alteration Score

Figure A5-10 shows a histogram of the SWAMP channel alteration score for RMC sampled sites. The data show a good distribution of natural channels and altered channels. An *a posteriori* regression could be developed to show the relationship trash monitoring data (e.g., qualitative Trash Condition site score) and degree of channel alteration to evaluate if this characteristic is a factor that affects trash in receiving waters. For example, natural channels may have more vegetation than altered channels, in which trash can be trapped and not discharged downstream.

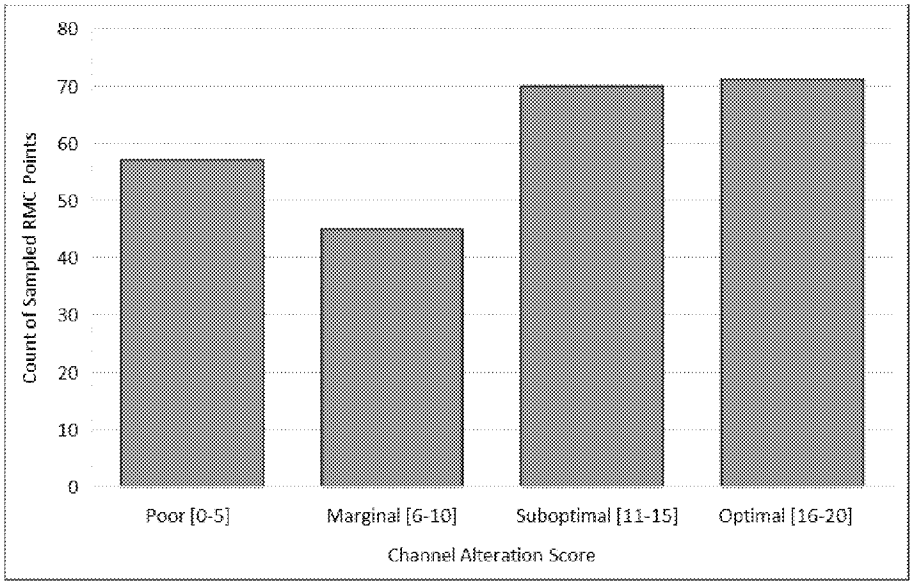


Figure 57-10. Histogram for RMC Sampled Sites SWAMP Channel Alteration Score

Attachment 6

Lists of Probabilistic Trash Monitoring Sites by County

Alameda County

Order	Site ID	Latitude	Longitude	Creek Name	City
1	204R00047	37.68826	-122.07257	NA	Castro Valley
2	204R00063	37.79660	-122.19974	Peralta Creek	Oakland
3	204R00068	37.69908	-121.80891	NA	Livermore
4	204R00084	37.70092	-121.92549	Dublin Creek	Dublin
5	204R00100	37.68258	-121.89614	NA	Pleasanton
6	205R00110	37.50273	-121.91225	Agua Caliente Creek	Fremont
7	205R00174	37.52816	-121.94772	NA	Fremont
8	204R00191	37.66584	-121.87840	Valle, Arroyo	Pleasanton
9	205R00279	37.51082	-122.00514	NA	Newark
10	204R00292	37.67869	-121.90884	Arroyo Mocho	Pleasanton
11	203R00295	37.88181	-122.30687	Codornices Creek	Berkeley
12	204R00303	37.68424	-122.08187	NA	Castro Valley
13	204R00319	37.79940	-122.21823	Sausal Creek	Oakland
14	204R00327	37.62009	-122.10072	NA	Hayward
15	204R00334	37.64659	-121.78812	Valle, Arroyo	County
16	204R00340	37.70218	-121.92074	NA	Dublin
17	204R00356	37.66871	-121.90931	Arroyo de la Laguna	Pleasanton
18	205R00366	37.51409	-121.91744	Aliso, Ca[a]ada Del	Fremont
19	204R00367	37.65958	-122.04169	NA	Hayward
20	204R00383	37.65909	-122.13676	Sulphur Creek	Hayward
21	204R00391	37.58682	-122.02358	NA	Union City
22	205R00430	37.48260	-121.93732	NA	Fremont
23	204R00447	37.65833	-121.86102	NA	Pleasanton
24	204R00455	37.64676	-122.03931	Zeile Creek	County
25	204R00473	37.67052	-121.76113	Arroyo Mocho	Livermore
26	205R00535	37.53933	-122.01855	NA	Newark
27	204R00575	37.73035	-122.19516	NA	Oakland
28	204R00583	37.61906	-122.05928	NA	Hayward
29	204R00596	37.70061	-121.90325	NA	Pleasanton
30	205R00622	37.54639	-121.95815	NA	Fremont
31	204R00623	37.69461	-122.04478	San Lorenzo Creek	County
32	204R00639	37.68137	-122.14430	San Lorenzo Creek	San Leandro
33	204R00647	37.60965	-122.01750	Dry Creek	Union City
34	205R00686	37.51235	-121.94389	Aliso, Ca[a]ada Del	Fremont
35	204R00724	37.69608	-121.94538	Dublin Creek	Pleasanton
36	204R00734	37.57243	-121.97261	Alameda Creek	Fremont
37	204R00852	37.71967	-121.91336	Alamo Creek	Dublin
38	205R00878	37.55459	-121.98700	NA	Fremont
39	204R00927	37.69521	-122.05672	Crow Creek	Castro Valley
40	204R00967	37.56848	-122.05929	NA	Fremont
41	203R00983	37.87505	-122.23659	Strawberry Creek	Oakland

Order	Site ID	Latitude	Longitude	Creek Name	City
42	204R01023	37.69403	-121.85899	Positas, Arroyo Las	Pleasanton
43	205R01070	37.49588	-121.90107	NA	Fremont
44	204R01087	37.81374	-122.19398	Palo Seco Creek	Oakland
45	204R01108	37.70703	-121.92703	NA	Dublin
46	205R01134	37.50051	-121.91561	Agua Caliente Creek	Fremont
47	205R01198	37.50878	-121.96660	NA	Fremont
48	205R01303	37.49701	-121.99045	NA	Fremont
49	204R01316	37.68457	-121.91542	Gold Creek	Pleasanton
50	204R01351	37.60535	-122.07871	Alameda Creek	Union City
51	204R01380	37.66264	-121.90626	Arroyo de la Laguna	Pleasanton
52	205R01390	37.53080	-121.97018	NA	Fremont
53	204R01391	37.64547	-122.03133	Zeile Creek	Hayward
54	204R01407	37.68581	-122.15618	NA	San Leandro
55	204R01433	37.71612	-121.74254	NA	Livermore
56	205R01454	37.50359	-121.96218	NA	Fremont
57	204R01471	37.69222	-121.86892	Arroyo Mocho	Pleasanton
58	204R01479	37.58229	-122.06515	NA	Union City
59	204R01572	37.68910	-121.92480	Gold Creek	Pleasanton
60	205R01582	37.50463	-121.90598	Agua Caliente Creek	Fremont
61	204R01599	37.69165	-122.16629	NA	San Leandro
62	204R01607	37.62605	-122.05022	NA	Hayward
63	204R01620	37.69773	-121.89989	NA	Pleasanton
64	204R01663	37.65411	-121.81013	Valle, Arroyo	County
65	204R01735	37.57482	-122.07164	NA	Union City
66	204R01759	37.66409	-122.05561	NA	Hayward
67	204R01791	37.70659	-121.87872	Tassajara Creek	Dublin
68	204R01828	37.67927	-121.90686	Arroyo Mocho	Pleasanton
69	205R01838	37.49337	-121.90866	NA	Fremont
70	204R01855	37.72823	-122.15025	NA	San Leandro
71	204R01863	37.57515	-122.01984	Alameda Creek	Fremont
72	204R01876	37.72070	-121.92112	South San Ramon Creek	Dublin
73	205R01902	37.52703	-121.93739	NA	Fremont
74	204R01945	37.71918	-121.74272	NA	Livermore
75	204R01951	37.69344	-122.07167	NA	Castro Valley
76	204R01991	37.57473	-122.05933	Coyote Hills Slough	Fremont
77	204R02015	37.67451	-122.05757	NA	County
78	204R02095	37.68572	-122.10347	San Lorenzo Creek	County
79	204R02116	37.69739	-121.81625	Positas, Arroyo Las	Livermore
80	204R02132	37.71029	-121.93006	NA	Dublin
81	204R02175	37.68454	-122.10825	San Lorenzo Creek	County
82	204R02183	37.56622	-121.99240	Alameda Creek	Fremont

Order	Site ID	Latitude	Longitude	Creek Name	City
83	205R02222	37.49859	-121.98448	NA	Fremont
84	204R02287	37.75567	-122.15483	Viejo, Arroyo	Oakland
85	204R02303	37.69463	-121.83866	Positas, Arroyo Las	Livermore
86	205R02327	37.52714	-122.03251	NA	Newark
87	205R02350	37.50578	-121.90118	Agua Caliente Creek	Fremont
88	204R02351	37.68643	-122.04430	NA	County
89	204R02375	37.64099	-122.07871	NA	Hayward
90	204R02404	37.65243	-121.90346	Arroyo de la Laguna	County
91	204R02431	37.67529	-122.15438	San Lorenzo Creek	San Leandro
92	204R02439	37.58765	-122.04057	Alameda Creek	Fremont
93	204R02457	37.69758	-121.73877	Seco, Arroyo	Livermore
94	205R02478	37.50027	-121.95446	NA	Fremont
95	204R02495	37.66656	-121.85506	Valle, Arroyo	Pleasanton
96	204R02503	37.59327	-122.05206	Alameda Creek	Union City
97	204R02527	37.66343	-122.07318	NA	Hayward
98	205R02583	37.51798	-122.00192	NA	Newark
99	204R02596	37.68947	-121.90010	NA	Pleasanton
100	205R02670	37.55083	-121.95170	NA	Fremont
101	204R02687	37.66101	-121.82442	Valle, Arroyo	County
102	204R02815	37.69729	-121.88090	Tassajara Creek	Pleasanton
103	204R02852	37.67367	-121.90653	NA	Pleasanton
104	204R02879	37.69224	-122.14314	NA	San Leandro
105	204R03015	37.58821	-122.07665	NA	Union City
106	205R03438	37.52406	-121.96912	NA	Fremont
107	205R03694	37.54533	-121.94308	NA	Fremont
108	204R03783	37.56722	-122.05749	NA	Fremont
109	205R03886	37.47742	-121.93189	NA	Fremont

Contra Costa County

Order	Site ID	Latitude	Longitude	Creek Name	City
1	207R00011	37.95427	-122.07869	Grayson Creek	Pleasant Hill
2	544R00025	37.92297	-121.71890	NA	Brentwood
3	207R00027	37.85048	-122.03107	San Ramon Creek	County
4	203R00039	37.89830	-122.30085	Cerrito Creek	Albany
5	543R00137	37.92211	-121.74002	NA	Brentwood
6	207R00139	37.88658	-122.08098	Las Trampas Creek	County
7	206R00155	37.87287	-122.17865	NA	Orinda
8	206R00215	37.95807	-122.27814	San Pablo Creek	County
9	207R00247	37.92925	-122.04751	Walnut Creek	Walnut Creek
10	207R00271	37.82651	-121.91876	NA	County
11	544R00281	37.95238	-121.69678	Marsh Creek	Brentwood
12	207R00283	37.88836	-122.12284	NA	Lafayette
13	544R00342	38.00704	-121.66883	NA	Oakley
14	207R00375	37.96209	-122.01407	Galindo Creek	Concord
15	207R00379	37.85224	-121.97756	Green Valley Creek	County
16	204R00388	37.80352	-121.89936	West Branch Alamo Creek	County
17	207R00395	37.89066	-122.10258	Las Trampas Creek	Lafayette
18	206R00407	37.94274	-122.30593	Wildcat Creek	Richmond
19	544R00457	37.99763	-121.68156	NA	Oakley
20	544R00464	38.02287	-121.82035	NA	Antioch
21	207R00503	37.95234	-122.02984	Pine Creek	Concord
22	207R00532	37.81527	-121.96726	NA	Danville
23	206R00551	37.96207	-122.33625	San Pablo Creek	San Pablo
24	207R00567	37.99528	-122.03836	NA	Concord
25	544R00598	38.00974	-121.67785	NA	Oakley
26	206R00599	37.97156	-122.30328	NA	County
27	207R00619	37.92852	-121.92762	Donner Creek	Clayton
28	207R00631	37.94515	-122.06595	NA	Pleasant Hill
29	207R00651	37.87545	-122.02232	NA	Walnut Creek
30	206R00727	37.97913	-122.26646	Pinole Creek	Pinole
31	207R00736	38.02505	-121.90465	NA	Pittsburg
32	207R00779	37.84714	-122.10892	Las Trampas Creek	Moraga
33	207R00788	37.80643	-121.98093	San Ramon Creek	Danville
34	207R00823	37.96493	-122.03602	Galindo Creek	Concord
35	207R00843	37.86806	-122.09589	Grizzly Creek	Lafayette
36	544R00854	38.00904	-121.69071	NA	Oakley
37	207R00880	38.03292	-121.96469	NA	County
38	207R00891	37.82838	-121.98444	Green Valley Creek	Danville
39	206R00919	37.96030	-122.26370	NA	Richmond
40	206R00960	38.00768	-122.22185	Rodeo Creek	Hercules
41	206R01024	38.01993	-122.25920	Rodeo Creek	County

Order	Site ID	Latitude	Longitude	Creek Name	City
42	544R01049	37.92213	-121.71938	Dry Creek	Brentwood
43	203R01063	37.89889	-122.29773	Cerrito Creek	El Cerrito
44	543R01103	37.98026	-121.81226	NA	Antioch
45	204R01156	37.79739	-121.88988	NA	County
46	207R01163	37.88713	-122.05534	San Ramon Creek	Walnut Creek
47	207R01227	37.87703	-122.04847	San Ramon Creek	Walnut Creek
48	207R01271	37.92031	-122.05124	Walnut Creek	County
49	207R01291	37.98503	-122.06891	Grayson Creek	County
50	544R01305	37.94454	-121.70527	Marsh Creek	County
51	207R01307	37.88612	-122.13754	NA	Lafayette
52	206R01319	37.96689	-122.35916	San Pablo Creek	County
53	544R01366	38.01184	-121.66809	NA	Oakley
54	204R01412	37.78737	-121.92374	West Branch Alamo Creek	San Ramon
55	207R01447	37.99012	-122.13346	NA	Martinez
56	544R01488	38.02241	-121.83508	NA	Antioch
57	207R01504	38.04010	-121.91760	NA	County
58	204R01519	37.81951	-122.11655	NA	Moraga
59	206R01536	38.00738	-122.27424	NA	Hercules
60	207R01556	37.80708	-121.95252	NA	Danville
61	206R01575	37.96803	-122.36549	San Pablo Creek	County
62	207R01591	37.99427	-122.03435	NA	Concord
63	204R01604	37.81911	-121.89583	West Branch Alamo Creek	County
64	207R01611	37.89093	-122.05594	San Ramon Creek	Walnut Creek

San Mateo County

Order	Site ID	Latitude	Longitude	Creek Name	City
1	202R00087	37.64474	-122.48009	NA	Pacifica
2	205R00088	37.37200	-122.21964	Corte Madera Creek	Portola Valley
3	205R00168	37.39680	-122.23231	NA	County
4	204R00180	37.57313	-122.36934	Sanchez Creek	Hillsborough
5	204R00200	37.52325	-122.34090	Polhemus Creek	County
6	204R00232	37.46354	-122.25150	Ojo De Agua, Arroyo	Redwood City
7	204R00244	37.47147	-122.24532	NA	Redwood City
8	202R00284	37.50515	-122.48723	Denniston Creek	County
9	204R00436	37.58173	-122.37066	Easton Creek	Burlingame
10	204R00520	37.51220	-122.29121	Belmont Creek	Belmont
11	204R00680	37.43798	-122.24128	NA	Woodside
12	204R00712	37.57048	-122.31361	San Mateo Creek	San Mateo
13	204R00807	37.65227	-122.42204	Colma Creek	South San Francisco
14	205R00872	37.42125	-122.24588	Bear Creek	Woodside
15	204R00884	37.57775	-122.38511	Easton Creek	County
16	202R00908	37.61128	-122.49336	NA	Pacifica
17	202R00972	37.51376	-122.45091	De En Medio, Arroyo	County
18	205R00984	37.42543	-122.26349	NA	Woodside
19	204R01012	37.47393	-122.26832	Cordilleras Creek	County
20	205R01192	37.39102	-122.23081	Corte Madera Creek	Portola Valley
21	204R01204	37.55711	-122.35379	NA	Hillsborough
22	204R01256	37.45452	-122.25050	NA	Redwood City
23	204R01268	37.46819	-122.23279	NA	Redwood City
24	204R01288	37.52354	-122.31202	NA	San Mateo
25	202R01308	37.46833	-122.43624	NA	Half Moon Bay
26	202R01356	37.57524	-122.46105	Middle Fork San Pedro Creek	Pacifica
27	204R01448	37.43459	-122.21776	NA	Atherton
28	204R01460	37.57675	-122.36808	Sanchez Creek	Hillsborough
29	202R01612	37.57810	-122.47139	Middle Fork San Pedro Creek	Pacifica
30	205R01704	37.43389	-122.26094	NA	Woodside
31	205R01816	37.36615	-122.21570	Corte Madera Creek	Portola Valley
32	204R01831	37.64853	-122.40701	Colma Creek	South San Francisco
33	204R01972	37.48375	-122.25730	Cordilleras Creek	Redwood City
34	204R02056	37.53342	-122.30243	Laurel Creek	San Mateo
35	204R02228	37.56114	-122.33698	San Mateo Creek	Hillsborough
36	204R02248	37.52659	-122.32286	Laurel Creek	San Mateo
37	204R02312	37.55186	-122.29133	NA	San Mateo
38	202R02332	37.47000	-122.44116	NA	Half Moon Bay
39	205R02408	37.38400	-122.23499	Bull Run Creek	Portola Valley
40	204R02504	37.53015	-122.34871	Polhemus Creek	County
41	204R02548	37.49544	-122.24336	Cordilleras Creek	Redwood City

Order	Site ID	Latitude	Longitude	Creek Name	City
42	205R02728	37.42452	-122.24954	NA	Woodside
43	204R02740	37.63800	-122.40412	NA	South San Francisco
44	205R02920	37.42376	-122.25112	NA	Woodside
45	205R03032	37.43720	-122.28319	NA	Woodside
46	204R03080	37.54858	-122.30551	NA	San Mateo
47	205R03095	37.48654	-122.13457	NA	Menlo Park

Santa Clara County

Order	Site ID	Latitude	Longitude	Creek Name	City
1	205R00003	37.36636	-121.87788	Coyote Creek	San Jose
2	205R00026	37.23057	-121.97137	Gatos Creek, Los	Los Gatos
3	205R00035	37.38145	-121.85669	Upper Penitencia Creek	San Jose
4	205R00042	37.24578	-121.77020	Coyote Creek	San Jose
5	205R00067	37.37693	-121.96857	Saratoga Creek	Santa Clara
6	205R00090	37.28807	-121.87920	Canoas Creek	San Jose
7	205R00099	37.30773	-122.02170	Calabazas Creek	San Jose
8	205R00115	37.40586	-122.06906	Stevens Creek	Mountain View
9	205R00131	37.43404	-121.91280	NA	Milpitas
10	205R00154	37.23400	-121.83759	Canoas Creek	San Jose
11	205R00218	37.29000	-121.81804	Coyote Creek	San Jose
12	205R00227	37.40990	-122.13831	Matadero Creek	Palo Alto
13	205R00234	37.26620	-121.99081	NA	Campbell
14	205R00241	37.27642	-121.76496	NA	San Jose
15	205R00259	37.36723	-121.92477	Guadalupe River	San Jose
16	205R00282	37.23760	-121.88840	Guadalupe Creek	San Jose
17	205R00291	37.31718	-121.84857	Coyote Creek	San Jose
18	205R00346	37.25973	-121.87010	Guadalupe River	San Jose
19	205R00355	37.32668	-121.99539	Saratoga Creek	Santa Clara
20	205R00374	37.19422	-121.82317	Alamitos Creek	County
21	205R00387	37.44558	-121.91085	Calera Creek	Milpitas
22	205R00419	37.32051	-122.06087	Stevens Creek	Cupertino
23	205R00451	37.38604	-121.90959	Coyote Creek	San Jose
24	205R00474	37.27875	-121.80782	Coyote Creek	County
25	205R00538	37.21790	-121.91401	NA	County
26	205R00547	37.34837	-121.98952	Calabazas Creek	Santa Clara
27	205R00554	37.24667	-121.99516	NA	Monte Sereno
28	205R00586	37.16552	-121.97919	Gatos Creek, Los	County
29	205R00602	37.22970	-121.86590	Alamitos Creek	San Jose
30	205R00627	37.39629	-121.98690	Calabazas Creek	Sunnyvale
31	205R00643	37.39196	-121.93946	Guadalupe River	San Jose
32	205R00659	37.33279	-121.80947	Thompson Creek	San Jose
33	205R00666	37.26924	-121.79665	Coyote Creek	San Jose
34	205R00707	37.39059	-121.84332	NA	San Jose
35	205R00714	37.23417	-121.97330	Gatos Creek, Los	Los Gatos
36	205R00739	37.42967	-122.12816	Matadero Creek	Palo Alto
37	205R00771	37.34063	-121.90213	Guadalupe River	San Jose
38	205R00787	37.40139	-121.79501	Upper Penitencia Creek	San Jose
39	205R00794	37.27208	-121.87787	Guadalupe River	San Jose
40	205R00851	37.43791	-121.87095	Coches, Arroyo De Los	Milpitas
41	205R00883	37.37073	-122.11758	Adobe Creek	Los Altos

Order	Site ID	Latitude	Longitude	Creek Name	City
42	205R00906	37.26905	-121.94881	Gatos Creek, Los	Campbell
43	205R00915	37.31472	-121.79615	Thompson Creek	San Jose
44	205R00938	37.26082	-121.99150	NA	Los Gatos
45	205R00979	37.35402	-121.84664	Silver Creek	San Jose
46	205R01027	37.35703	-121.91413	Guadalupe River	San Jose
47	205R01091	37.35753	-121.97321	Saratoga Creek	Santa Clara
48	205R01098	37.20973	-121.90271	Guadalupe Creek	San Jose
49	205R01114	37.28450	-121.88231	Guadalupe River	San Jose
50	205R01139	37.42068	-122.06852	Stevens Creek	Mountain View
51	205R01155	37.44656	-121.92332	Coyote Creek	Milpitas
52	205R01187	37.30311	-122.07480	Stevens Creek	Cupertino
53	205R01226	37.29761	-121.92911	Gatos Creek, Los	San Jose
54	205R01283	37.30879	-121.88501	Guadalupe River	San Jose
55	205R01299	37.39810	-121.78602	Arroyo Aguague	San Jose
56	205R01306	37.24871	-121.91384	Ross Creek	San Jose
57	205R01315	37.32263	-121.85837	Coyote Creek	San Jose
58	205R01347	37.45348	-121.92397	NA	Milpitas
59	205R01411	37.38842	-121.96863	Saratoga Creek	Santa Clara
60	205R01434	37.21387	-121.83438	Calero, Arroyo	San Jose
61	205R01443	37.31489	-122.06161	Stevens Creek	Cupertino
62	205R01539	37.31493	-121.90334	Gatos Creek, Los	San Jose
63	205R01562	37.21995	-121.92418	NA	County
64	205R01578	37.24043	-122.00584	NA	County
65	205R01610	37.15754	-121.97052	Gatos Creek, Los	County
66	205R01651	37.41775	-122.01893	NA	Sunnyvale
67	205R01667	37.39699	-121.94120	Guadalupe River	San Jose
68	205R01669	37.16628	-121.64787	Coyote Creek	Morgan Hill
69	205R01706	37.26551	-122.02578	Saratoga Creek	Saratoga
70	205R01715	37.35606	-122.11071	NA	Los Altos Hills
71	205R01731	37.39265	-121.83477	Upper Penitencia Creek	County
72	205R01738	37.23844	-121.94789	Ross Creek	County
73	205R01747	37.35223	-121.84211	Silver Creek	San Jose
74	205R01818	37.26860	-121.87780	Guadalupe River	San Jose
75	205R01882	37.23577	-121.87047	Alamitos Creek	San Jose
76	205R01923	37.42266	-121.90707	NA	Milpitas
77	205R01930	37.26308	-121.95209	Gatos Creek, Los	Campbell
78	205R01962	37.26295	-121.99919	NA	Saratoga
79	205R02003	37.36389	-121.87499	Coyote Creek	San Jose
80	205R02051	37.34548	-121.90422	Guadalupe River	San Jose
81	205R02074	37.23195	-121.87455	NA	San Jose
82	205R02090	37.24387	-121.76662	NA	San Jose
83	205R02119	37.36044	-122.20276	Trancos Creek, Los	Portola Valley

Order	Site ID	Latitude	Longitude	Creek Name	City
84	205R02154	37.24502	-122.03136	Wildcat Creek	Saratoga
85	205R02179	37.43193	-121.92760	Coyote Creek	Milpitas
86	205R02211	37.30555	-122.07191	Stevens Creek	Cupertino
87	205R02250	37.27869	-121.94578	Gatos Creek, Los	Campbell
88	205R02307	37.29904	-121.92683	Gatos Creek, Los	San Jose
89	205R02330	37.25520	-121.90656	Ross Creek	San Jose
90	205R02405	37.17137	-121.68168	Coyote Creek	San Jose
91	205R02422	37.21059	-121.82717	Calero, Arroyo	County
92	205R02435	37.40162	-121.97067	Saratoga Creek	Santa Clara
93	205R02458	37.21897	-121.84321	Alamitos Creek	County
94	205R02474	37.25819	-122.03437	Saratoga Creek	Saratoga
95	205R02538	37.27538	-122.04225	Calabazas Creek	Saratoga
96	205R02547	37.31243	-122.16309	Stevens Creek	Palo Alto
97	205R02563	37.32924	-121.89960	Gatos Creek, Los	San Jose
98	205R02602	37.23547	-122.00528	NA	County
99	205R02618	37.17623	-121.98942	Aldercroft Creek	County
100	205R02650	37.22150	-121.84700	Alamitos Creek	San Jose
101	205R02659	37.34474	-122.06417	Stevens Creek	Sunnyvale
102	205R02673	37.21731	-121.73623	Coyote Creek	County
103	205R02691	37.40707	-121.97631	Saratoga Creek	Santa Clara
104	205R02730	37.28141	-122.00642	Saratoga Creek	Saratoga
105	205R02762	37.23593	-121.95184	Ross Creek	Los Gatos
106	205R02771	37.35228	-121.83543	Silver Creek	San Jose
107	205R02835	37.39658	-121.80390	Upper Penitencia Creek	San Jose

Solano County

Order	Site ID	Latitude	Longitude	Creek Name	City
1	207R00300	38.24275	-122.01110	NA	Suisun City
2	207R00428	38.26279	-122.03737	NA	Fairfield
3	207R00476	38.24668	-122.07040	NA	Fairfield
4	207R00556	38.26025	-122.03806	NA	Fairfield
5	207R00684	38.28498	-122.03904	NA	Fairfield
6	207R01452	38.26364	-122.01956	Soda Springs Creek	Fairfield
7	207R01516	38.22563	-122.14991	Green Valley Creek	Fairfield
8	207R01580	38.24175	-122.04349	NA	Suisun City
9	207R01772	38.22037	-122.14626	Green Valley Creek	Fairfield
10	207R02108	38.19303	-122.14426	NA	Fairfield
11	207R02604	38.23990	-122.06209	NA	Fairfield
12	207R02732	38.28796	-122.02075	Soda Springs Creek	Fairfield

Attachment 7

Standard Operating Procedures and Data Collection Forms for

Qualitative Trash Assessments and Quantitative Trash Monitoring In Receiving Waters

STANDARD OPERATING PROCEDURES AND DATA COLLECTION FORMS FOR QUALITATIVE TRASH ASSESSMENTS AND QUANTITATIVE TRASH MONITORING IN RECEIVING WATERS

Bay Area Stormwater Management Agencies Association (BASMAA)

VERSION 1.0

1. Introduction

The following Standard Operating Procedure (SOP) describes the trash receiving waters monitoring protocol that will be implemented during the pilot-testing phase (October 2017 – February 2020) of the BASMAA Trash Monitoring Program Plan. The protocol includes a *qualitative* and *quantitative* method for measuring trash accumulation in a geographically defined assessment area located in creeks, channels, rivers, lagoons and shorelines within the jurisdictional areas of BASMAA member agencies. The protocols and methods in this SOP are based on a review of historical and current receiving water monitoring efforts for trash.

1.1. TYPES OF ASSESSMENTS AND MONITORING

Qualitative Assessment: The qualitative method is based on a visual survey technique that documents the levels of trash within the creek/river channel/shoreline and the relative contribution of trash from different transport pathways. The qualitative method may be applied to an assessment area that is defined prior to implementing the protocol. In general, the qualitative method provides a cost-effective approach to evaluate changes in trash conditions in receiving waters at numerous assessment areas at higher frequencies over time (e.g., evaluating seasonal and yearly changes). Additionally, the qualitative method is best used when attempting to detect relatively substantial changes in the levels of trash observed over a defined time period.

Quantitative Monitoring: The quantitative method includes the measurement of trash volume that is collected from a specific assessment area. The quantitative assessment method is more suitable for use at assessment sites that will be the focus of specific management actions, situations that require more refined estimates of trash volumes, or projects that have the goal of detecting relatively small changes in the levels of trash observed in receiving waters over a relatively short timeframe.

There are three major steps included in this SOP:

- **Step 1:** Defining the boundaries of **Assessment Area,** which forms the extent of where the protocol is conducted;
- **Step 2:** Conducting a **Qualitative Assessment** of trash levels and estimating the relative contributions of trash pathways. The assessment also includes an evaluation of the vegetative cover and structure/composition observed in the assessment area; and

- **Step 3:** Conducting a **Quantitative Assessment** of trash volumes and types by: a) collecting and removing trash from the assessment area; and b) calculating the total volume of trash associated with different transport pathways;

Steps 1 and 2 will be conducted at all probabilistic sites and steps 1-3 will be conducted at all targeted sites. When both qualitative and quantitative assessments are planned at a site, they should be performed in the order presented within this SOP.

1.2. PERSONNEL ROLES AND RESPONSIBILITIES

There are three main roles that will be filled by each Stormwater Program to ensure the effective implementation of the program and QA/QC procedures. Each role and responsibility is described below.

- **Monitoring Project Manager** – Main responsibility will be to oversee and coordinate all aspects of the receiving water trash monitoring program for his/her Stormwater Program. Responsibilities will include conducting/coordinating the appropriate training of the Field Crew Supervisor(s) and Field Crew Members; selecting probabilistic and targeted sites; coordinating the management of all data collected during monitoring/assessment events; overseeing and conducting all QA/QC procedures; and overseeing the interpretation and reporting of the data.
- **Field Crew Supervisor(s)** – One or more individuals for each Stormwater Program that will oversee field assessment and/or monitoring activities at specific sites or events, and Field Crew Members assisting with monitoring/assessments. The Supervisor should be trained in the protocol and use of the data collection form; present at all applicable assessment/monitoring events; lead the recording of information on the data collection forms, including condition assessments, vegetative cover/structure assessments, volume measurements and pathway analysis; and participating in QA/QC procedures in the field.
- **Field Crew Members** – One or more individuals for each Stormwater Program that assists the Field Crew Supervisor in conducting qualitative assessments and quantitative monitoring. Field Crew Members are not required to go through formal training, but should have read the protocol and understand the field safety procedures.

2. Project Planning

2.1. SITE EVALUATION

Prior to the first monitoring event, the Monitoring Project Manager, in coordination with the Field Crew Supervisor(s), should attempt to gain access to the required number of targeted and probabilistic sites (and alternative sites should one or more sites not be accessible or safe), conduct field reconnaissance at the sites where access is granted, and document final site list. Reconnaissance can be conducted using a combination of office and field site evaluations. Field visits should evaluate if the site is accessible and safe for conducting visual trash assessments or conducting quantitative monitoring. The Monitoring Project Manager should manager the final site list.

2.2. FIELD MOBILIZATION

One or two days prior to trash assessment, The Field Crew Supervisor and Field Crew Members should complete/assemble the following materials and supplies for the field:

Material/Supplies	Trash Assessment Protocol	
	Qualitative	Quantitative
Paperwork (Site Evaluation Field Form, Trash Monitoring Plan SOP, field datasheets, maps, permits, gate keys)	X	X
Measuring tape	X	X
Flagging and/or stakes	X	X
Camera	X	X
Cell phone	X	X
GPS (could be cell phone)	X	X
First aid kit	X	X
Rubber boots or chest/hip waders	X	X
Super-heavy duty plastic trash bags and twist ties		X
Five-gallon buckets		X
Labels and marker to write on labels		X
Container for hazardous waste items		X

The Field Crew Supervisor or Monitoring Project Manager should schedule the trash assessment dates and locations with contracted parties that will be performing the clean-up and will haul the trash collected during the quantitative monitoring portion of the protocol (if applicable) to the landfill and recycling facility.

2.3. HEALTH AND SAFETY

Prior to conducting trash assessments, the Field Crew Supervisor should debrief field crews regarding health and safety issues. Some information, such as potential presence of illegal encampments and sensitive wildlife species should be gathered several days prior to field visits. The Field Crew Supervisor should conduct a tailgate meeting immediately prior to conducting the assessments. Health and safety issues include, but are not limited to:

- ✓ General safety and awareness of surroundings – deep water, steep banks, poison oak, blackberry bushes.
- ✓ Avoidance of deep spots in the channel and show caution for submerged objects while walking through the channel.
- ✓ Always work in groups of two crew members.
- ✓ Need to wear gloves to protect hands when collecting trash.
- ✓ Prevention of heat exhaustion and dehydration.
- ✓ Use of proper lifting techniques.
- ✓ Illegal encampments – Do not approach or interact with people living in camp. Do not remove items from an active camp. Follow existing protocols associated with illegal encampments.
- ✓ Hazardous materials – Do not remove any of the following hazardous items: sharps (syringes, razors, knives) or batteries, propane tanks etc. These items should be properly disposed of by staff who are trained and prepared for handling hazardous waste.

- ✓ Fecal material – Do not touch or remove any trash contaminated with feces. This material should be properly disposed of by staff who are trained and prepared for handling biowaste.
- ✓ Need to avoid disturbing wildlife, including nesting birds and wood rats. Steps to identify and avoid sensitive species habitat will be addressed during protocol training.

3. Defining Trash Monitoring/Assessment Areas

This section summarizes the process that Field Crew Supervisors and Crew Members will use to delineate the area where qualitative visual assessments and/or the removal of trash for quantitative monitoring will be conducted. Because the assessment area differs by receiving water type, assessment area delineation procedures for creeks, channels and the Bay shoreline are discussed separately below.

3.1. LENGTH OF ASSESSMENT AREA

The minimum length of the assessment area for assessment/monitoring sites is 300 feet for creeks, channel and rivers, which is consistent with a majority of the RMC probabilistic sites and Trash Hot Spots. The minimum length for shoreline locations is 600 feet, which is consistent with Trash Hot Spots at shoreline locations. At each monitoring site, the length of the trash assessment area will be measured and GPS coordinates and easily identified landmarks at the upstream and downstream ends of the reach will be documented. For the purpose of photo documentation, the assessment reach is divided into 100-foot segments that can be distinguished using easily removable markers (e.g., surveyor's flags).

3.2. WIDTH OF ASSESSMENT AREA

The width of an assessment area should be measured at three locations for creek and shoreline sites. These measurements will be used to calculate average width of the assessment area. For creek, channel and river sites, measurements should be taken at the furthest downstream location, roughly midway, and the furthest upstream location of the 300-foot assessment area. For shoreline sites, measurements should occur at the starting point, midpoint and end point of the 600-foot assessment area.

Measurements should be made by placing a tape measure or hip chain onto the ground, and measuring the width along the ground from one width boundary to the other width boundary (e.g., tops of bank). Field crews should mark the boundary of the assessment area during the initial monitoring event to facilitate future assessments. Assessment area widths only need to be measured once, prior to the first monitoring event, given that all area markers can be seen during subsequent events.

Creeks/Rivers/Channels - To the extent possible, the assessment area width for sites on creeks, channels and rivers will extend to the "top of bank". Top of bank refers to the creek or channel boundary where a majority of normal discharges and channel-forming activities takes place. The top of bank boundary will contain the active stream channel, active floodplain, and its associated banks. For sites where the top of bank is not accessible or safe for field crews to access, the width of the assessment area will be documented using the methods described above. Figures

showing how to delineate an assessment area for creeks/channels/rivers, and the Bay shoreline locations are included in **Attachment A**.

Shorelines - For lagoon and Bay shoreline sites, the shoreline assessment area width is delineated as appropriate, based on a change in substrate material, presence of a line of upland vegetation, or onset of development. Similar approach for delineating segments and measuring assessment widths and photo documentation described in previous section should be conducted.

4. Conducting the Assessment/Monitoring Event

4.1. GENERAL SITE INFORMATION

This section describes procedures for completing the Section I (Trash Assessment Area and General Site Information) of the Receiving Water Trash Assessment Data Collection Form (**Attachment 2**).

4.1.1. Assessment Area Information

On the data collection form, complete all information associated with the location and boundaries of the assessment area. This includes the receiving water body name, associated jurisdiction(s), length and widths of the assessment area, GPS (lat/long) coordinates for the upper and lower (longitudinal) boundary of the area, channel type (for creek/river sites) and applicable land uses adjacent to the area.

4.1.2. Number and Diameter of Stormwater Outfalls

Record the number and diameter of stormwater outfalls greater than 18 inches in diameter that were observed in the assessment area. Outfalls less than 18 inches within the assessment area, and outfalls observed outside of the assessment area should not be recorded.

4.1.3. Previous Trash Clean Up

Record the date and entity that performed a trash cleanup prior to the trash assessment event, but after the most recent assessment at the site (if applicable). Select "unknown" to indicate that it is unclear as to whether a cleanup event occurred during this timeframe.

4.2. QUALITATIVE TRASH ASSESSMENT

This section describes procedures for completing the Section II (Trash Condition and Pathways) of the Receiving Water Trash Assessment Data Collection Form (**Attachment 2**).

4.2.1. Trash Condition Category and Site Score

The qualitative assessment is a visual survey technique performed by at least two crew members (one being the Field Crew Supervisor) that documents the levels of trash within the creek, engineered channel, or on the shoreline; and the estimates the relative contribution of trash from different transport pathways. The Field Crew Supervisor should first walk the entire assessment area and score the site based on their "first impression" of the amount of trash observed. The trash condition is divided into four condition categories that include narrative descriptions of

trash levels associated with a scoring range (1 – 12) as follows: Low (1-3), Moderate (4-6), High (7-9), Very High (10-12) (**Table 1**). Example photographs for each trash condition category are provided in **Attachment 3**.

Observers should physically walk on both banks and within or near the creek/channel (where feasible) to observe trash throughout the assessment area. Feasible conditions refer to flow conditions that allow the stream to be wadeable, in addition to conditions that would avoid impacts to migratory nesting birds and fish spawning. Trash that is visible outside of the assessment area should not to be included in the trash condition score, but should be noted in the comments section of the data form.

Table 1. Trash condition categories and scoring system for qualitative assessments of receiving waters.

Condition Category			
Low	**Moderate**	**High**	**Very High**
• Effectively no or very little trash • On first glance, little or no trash is visible • Little or no trash is evident when streambed and stream banks are closely examined for litter and debris • One individual could easily remove all trash observed within 30 minutes	• Predominantly free of trash except for a few littered areas • On first glance, trash is evident in low levels • After close inspection, small levels of trash are evident in stream bank and/or streambed. • On average, all trash could be cleaned up by two individuals within 30 minutes to one hour. • Approximately 2-3 times more trash than the low condition category	• Predominantly littered except for a few clean areas • Trash is evident upon first glance in moderate levels along streambed and banks • Evidence of site being used by people: scattered cans, bottles, food wrappers, plastic bags, etc. • On average, would take a more organized effort (more than 2 people, but less than 5) to remove all trash from the area. Removal of trash would take 30 mins to 2 hours. • Approximately 2-6 times more trash than the moderate condition category	• Trash is continuously seen throughout the assessment area • Trash distracts the eye on first glance • Substantial levels of litter and debris in streambed and banks • Evidence of site being used frequently by people (e.g., many cans, bottles, food wrappers, plastic bags, clothing; piles of garbage and debris) • On average, would take a large number of people (more than 5) during an organized effort to remove all trash from the area. Removal of all trash would take more than 2 hours. • Approximately 2 or more times trash than the high condition category
1 2 3	**4 5 6**	**7 8 9**	**10 11 12**

4.2.2. Vegetative Condition Assessment

On data collection form, separately assess the proportion (%) of the assessment area that is covered by vegetation or vegetative debris (i.e., large wood debris) for: 1) stream banks (combined area for both banks, including vegetated islands if present); and 2) the stream channel (wetted and/or dry). Percent cover for both areas of the assessment area is estimated using the categories listed in Table 2.

Table 2. Vegetated or vegetated debris cover categories for stream banks and channel.

Assessment Area	Category	Definition
Banks	Ground Cover	Grasses, vines, weeds and other non-woody plants generally < 2 feet in height;
	Understory	Woody plants such as shrubs, poison oak, black berries and other plants and trees that are between 2 and 10 feet in height;
	Trees, Roots and other woody material	Living trees/roots along toe of bank, other natural woody debris material
	Bare Ground	Soil, concrete and other bank armoring material
Channel	Woody Debris	Logs, sticks, branches, and other natural woody material
	Aquatic Vegetation	Vegetation growing within the channel (e.g., grasses, rushes, sedges, water cress, water lily)
	Algae	Filamentous or floating algal mats
	No vegetation or woody debris	Wetted or dry channel bed

Collecting this information will be helpful in assessing whether the amount and type of vegetation affects the transport and accumulation of trash at a site.

4.2.3. Trash Pathways

Once the overall trash condition category and site score have been recorded, The Field Crew Supervisor will estimate the percentage of trash observed that is attributable to one or four trash transport pathway categories:

1. Litter/Wind
2. Illegal Encampments
3. Illegal Dumping
4. Unknown/Other (e.g., Stormwater and Unidentifiable Upstream Sources)

Table 3 includes factors that may help estimate the relative contributions from each pathway. Each pathway should be assigned a percentage between 0 and 100% (increments of 10%) of the total trash observed in the trash assessment area. There will be a high level of uncertainty associated with defining pathways for each of the trash items due to the inherent difficulty of assessing all the potential ways trash can enter the assessment area. As a result, the relative proportion of trash pathways should be considered a very rough estimate.

Table 3. Trash items typically associated with four types of transport pathways.

Trash Pathway	Trash Characteristics	Potential Location in Assessment Area	Example Trash Items
Litter/Wind	- Light weight - Distributed evenly, recent/not worn	- Adjacent to or under freeways and road crossings - Near roadways, bike or foot paths adjacent to the water body	- Fast food items - Paint spray cans - Carryout plastic grocery bags - Paper - Styrofoam
Illegal Encampments	- Large items - Dense, multiple piles near current or abandoned camping site - No sign of water damage	- Adjacent to camps or trails - Banks, above and below high water mark - Under bridges	- Mattresses - Fast food items - Bagged trash - Large items - Fabric and cloth - Cardboard/paper - Metal cans/debris - Glass Bottles/pieces - Food Containers
Illegal Dumping	- Large items - Recent - Large piles, adjacent to roads	- Directly upstream or downstream of bridges - Near roadways	- Furniture - Bags of trash - Construction debris - Fabric and cloth - Mattresses - Tires
Unknown/Other (e.g., Stormwater, and Unidentifiable Upstream Sources)	- Small, persistent, transportable - Old, worn, water damaged - Integrated with vegetation, debris - Well distributed and mixed with debris	- Wetted channel - Banks below high water line - Directly below outfalls	- Polystyrene food ware - Cigarette butts & wrappers - Food wrappers - Plastic bottles/cups - Plastic straws/caps - Carryout plastic grocery bags - Rubber balls/tape - Paper fragments

4.2.4. Photo Documentation

Each trash monitoring/assessment event will include photo documentation of the assessment area. Standardized photo documentation procedures are currently implemented by Permittees at all trash hot spot areas and these same procedures will be used during both qualitative assessment and quantitative monitoring events. If only a qualitative assessment is being conducted at the site, then the photo documentation should be recorded in this section. If

quantitative monitoring is being conducted at the site (i.e., trash is being collected and removed from the assessment area), documentation of photographs should be recorded in the in Quantitative Monitoring Section (Section III) of the data collection form. A summary of the photo documentation procedures are as follows:

1. **Establish Photo Documentation Segments**

   Evenly divide trash assessment area into 100 foot intervals by placing easily removable markers (e.g., surveyor's flags) along the creek bank. For assessment areas that are 300 feet in length, label the segments A to C, beginning at the furthest downstream. If an assessment area is greater than 300 feet in length, continue to mark 100 ft segments until you reach the most upstream point your hot spot. For example, trash hot spot locations on shorelines are typically 600 feet in length and would thus have six (6) 100 foot long segments, which would get labeled A to F.

2. **Photograph Trash Conditions within Segments**

   Digital photographs are used to show trash conditions over time at the same spot within each segment of the site. A minimum of three (3) photographs should be taken at each site. Photographs will be taken at segment A, B and C **looking upstream** and should illustrate the extent and magnitude of trash within each segment. Photographs should be taken as close to the middle of the active channel as possible. Field crews may choose to take additional photos taken beyond the three required to illustrate trash levels/conditions at the site. These photos should also be identified on the data collection form.

4.2.5. Comments

Field crews should attempt to record any comments about the site that would assist in interpreting the data collected via the qualitative assessment SOP. This may include, but should not be limited to, important sources or levels of trash in areas adjacent to the assessment area where the qualitative visual assessment is being conducted, or identification of areas within the assessment area that may not have been observed due to safety risk or access issues. Structures other than vegetation or vegetative debris that are present in the assessment area should also be described in the comments section.

4.3. QUANTITATIVE TRASH MONITORING

Quantitative measurements will be performed at all targeted monitoring sites (including selected trash booms) by collecting all trash from the assessment area (or captured by the trash boom). Trash items that are not visible during the assessment and/or cannot be safely accessed by field crew will not be included in the assessment, but should be noted in the comment section on the data collection form. Non-visible trash may include items on the bottom of the wetted channel or buried under dirt and debris on banks or within dry channel bed. Inaccessible trash may include items trapped in tree branches, dense vegetation (e.g., blackberry bushes) or on steep banks that cannot be safely accessed. If monitoring site contains active illegal encampments field monitoring staff will visually estimate the total volume of trash associated with the encampment and plan the removal of trash by properly trained personnel at a later date.

4.3.1. Estimate Trash Volume

After completing a qualitative assessment, the first step when conducting quantitative monitoring is to collect all trash from the assessment area and estimate its volume. Trash outside of the defined assessment area should not be collected or quantified as part of this protocol. Trash associated with each of the four different transport pathways should be quantified separately. All trash items are categorized into one of the four transport pathways using three characteristics: 1) type of trash, 2) trash condition/depositional pattern, and 3) location within assessment area (see Table 2).

Relatively small trash items associated with each transport pathway should be collected in 5-gallon buckets (with handles) or super heavy-duty trash bags of a known size. The outside of buckets should be marked with a permanent marker in 0.5 gallon increments. Once the bucket is full (i.e., level with the top of the bucket) empty into a super heavy-duty plastic garbage bag (e.g., 30 gallons). For partially filed buckets, estimate volume using 0.5 gallon increments. For trash volumes less than 0.5 gallons, mark "< 0.5" on the field data collection form. Small trash items that should be included in buckets/bags include the following:

- Food Wrappers
- Takeout Food Containers and Utensils
- Glass and Plastic Bottles
- Clothing/Shoes
- Sports Balls
- Spray Paint Cans
- Small Styrofoam
- Aluminum, Steel and Tin Cans
- Cigarette Butts
- Single Use Plastic Bags
- Small Automotive Related Items
- Paper Products
- Cardboard

Trash that is placed in buckets and bags should be un-compacted. Garbage bags should not be filled with more than 40 to 50 pounds of material. If material contains sharp or large objects, "double bag" the material, as necessary. Use multiple garbage bags per assessment site, if needed. Total number buckets and volume of collected trash is recorded on the Receiving Water Trash Assessment Data Collection Form (**Attachment 2**). All biohazards and hazard waste should be separated and handled appropriately by trained staff.

Materials that are too large to be placed in buckets or bags should be stacked together (by pathway) and the volume should be estimated visually. Estimates of large items (e.g., construction materials or appliances) should be made in cubic feet or cubic yards and recorded on the Receiving Water Trash Assessment Data Collection Form (**Attachment 2**). Large items may include, but are not limited to, the following:

- Shopping Carts
- Mattresses
- Coolers
- Furniture
- Appliances
- Tires
- Bicycles,
- Construction Debris
- Automobile Parts
- Large Bags of Trash

4.3.2. Identify Most Prevalent Trash Types

Field crews will identify the five most frequently observed types of trash when conducting quantitative monitoring. The five most prevalent trash items (by number) observed will be circled on the field datasheet. If an item is not present on the list, crew members may write in an item under "other."

4.3.3. Photo Documentation

Photo documentation procedures described in section 5.3 will be followed when conducting quantitative monitoring. Additionally, a minimum of one photograph will be taken at each of three segments (A, B and C) **before and after** the collection and removal of trash, resulting in a total of 3 before and 3 after (cleanup) photographs for 300-foot creek assessment areas. Photographs for monitoring sites greater in length (e.g., shorelines) should be taken at each 100-foot segment. Photo documentation of bagged and un-bagged trash should be taken prior to trash disposal.

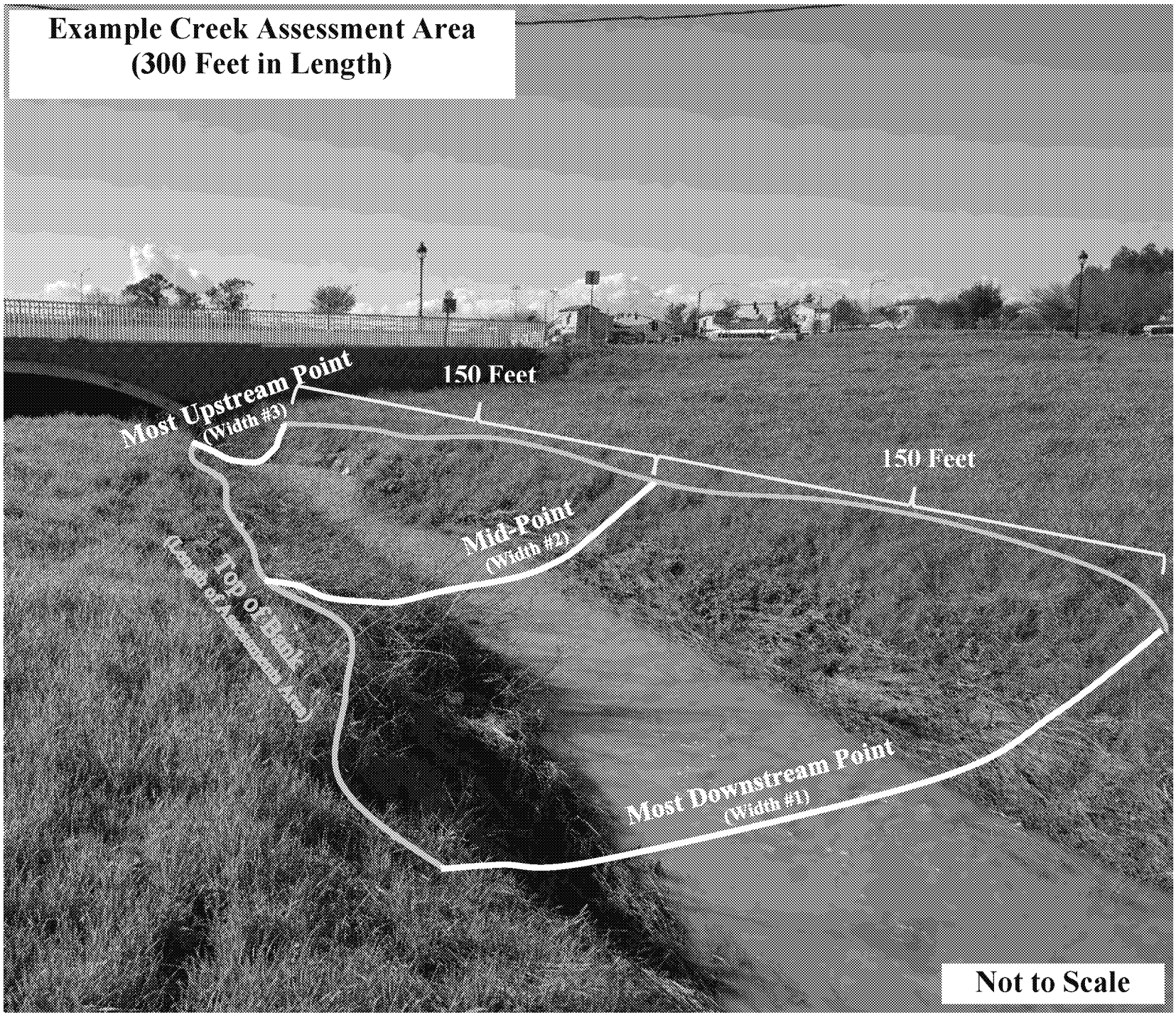
4.3.4. Resources and Time Expended

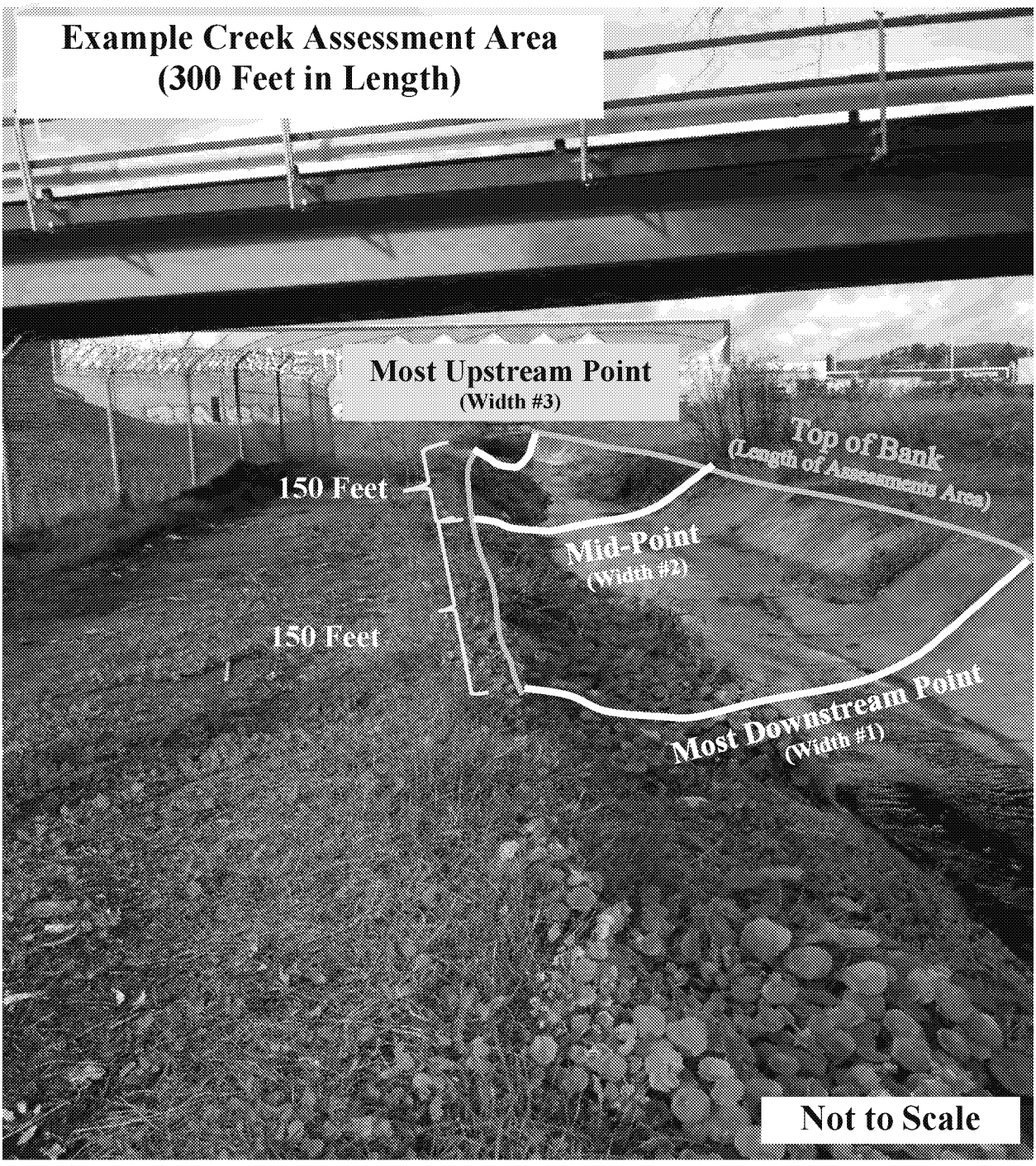
The Field Crew Supervisor should record the number of field crew members that assisted with the quantitative monitoring event, including the removal and disposal of trash in the site. Additionally, the number of person hours in total spent during the quantitative assessment event (including travel time to and from the event) should be recorded.

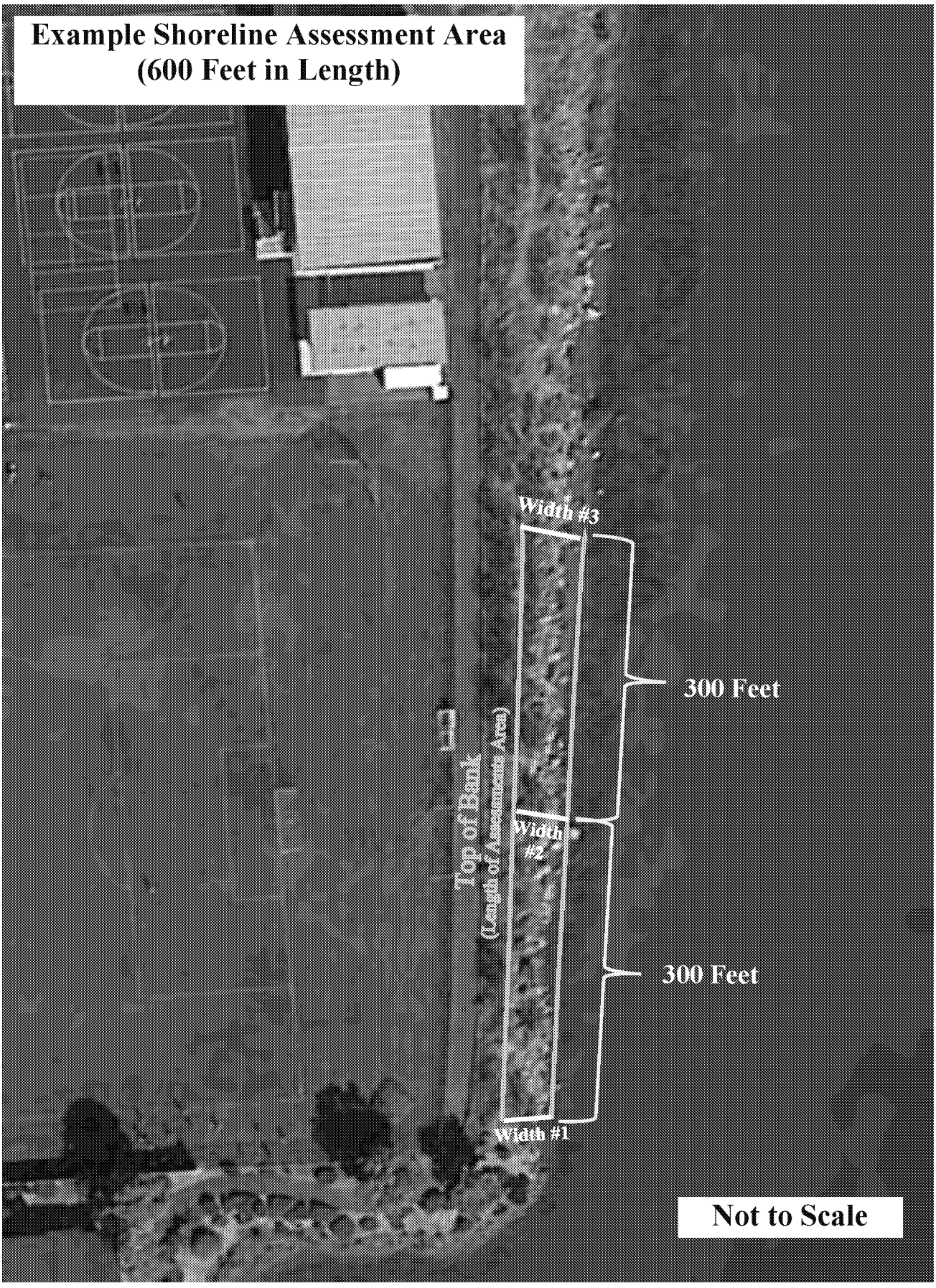
ATTACHMENT 1

GUIDANCE FOR DEFINING TRASH ASSESSMENT AREA

June 2017


Example Creek Assessment Area
(300 Feet in Length)
Most Upstream Point
(Width #3)
150 Feet
150 Feet
Mid-Point
(Width #2)
Most Downstream Point
(Width #1)
Not to Scale


Example Creek Assessment Area
(300 Feet in Length)
Most Upstream Point
(Width #3)
Top of Bank
(Length of Assessment Area)
150 Feet
Mid-Point
(Width #2)
150 Feet
Most Downstream Point
(Width #1)
Not to Scale


Example Shoreline Assessment Area
(600 Feet in Length)
Width #3
300 Feet
Top of Bank
(Length of Assessment Area)
Width #2
300 Feet
Width #1
Not to Scale

ATTACHMENT 2

DATA COLLECTION FORMS

June 2017

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

Date:_____ **Time Start:**_____ **Time End:** _____

Field Crew Supervisor: _____ **Crew Members:**_____

I. General Site Information and Trash Assessment Area

Site ID

Receiving Waterbody Name: _____ **Jurisdiction:**_____

Channel Type: ☐ Natural ☐ Earthen ☐ Concrete ☐ Other _____

Type of Site (check one): **Probabilistic** ☐ **Targeted** ☐

Assessment Area (Measure in the field using tape)

Total Length (feet) _____

Width (feet): Downstream/Start_____ Midpoint_____ Upstream/End_____

GPS coordinates (latitude / longitude):

Downstream/Start_____/_____ Upstream/End_____/_____

Land Uses Adjacent to Assessment Area

▶ **Check all that apply**:

☐ Residential (Single-family) ☐ Residential (Multi-family) ☐ Commercial ☐ Urban Park ☐ Freeway

☐ Industrial ☐ Public ☐ Open Space ☐ Mixed-use ☐ Other Developed ☐ Institutional

Stormwater Outfalls

▶ **Number of stormwater outfalls in the assessment areas > 18 inches in diameter**

18" to 24" _____ 24" to 36" _____ 36" to 48" _____ > 48" _____

Previous Cleanup Events

▶ **Has a cleanup event occurred at the site since the last qualitative assessment event?**

☐ Yes ☐ No ☐ Unknown

If YES, record the dates on the previous Trash Cleanup Event(s):

Date: _____ Entity:_____

Date: _____ Entity:_____

Date: _____ Entity:_____

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

II. Qualitative Assessment - Trash Condition and Pathways

	Trash Condition Category			
	Low	**Moderate**	**High**	**Very High**
Description	• Effectively no or very little trash • On first glance, little or no trash is visible • Little or no trash is evident when streambed and stream banks are closely examined for litter and debris • One individual could easily remove all trash observed within 30 minutes	• Predominantly free of trash except for a few littered areas • On first glance, trash is evident in low levels • After close inspection, small levels of trash are evident in stream bank and/or streambed. • On average, all trash could be removed by two individuals within 30 minutes to one hour. • Approximately 2-3 times more trash than the low condition category	• Predominantly littered except for a few clean areas • Trash is evident upon first glance in moderate levels along streambed and banks • Evidence of site being used by people: scattered cans, bottles, food wrappers, plastic bags etc. • On average, would take a more organized effort (more than 2 people, but less than 5) to remove all trash from the area. Removal of trash would take 30 mins to 2 hours. • Approximately 2-6 times more trash than the moderate condition category	• Trash is continuously seen throughout the assessment area • Trash is distracts the eye on first glance • Substantial levels of litter and debris in streambed and banks • Evidence of site being used frequently by people (e.g., many cans, bottles, food wrappers, plastic bags, clothing; piles of garbage and debris) • On average, would take a large number of people (more than 5) during an organized effort to remove all trash from the area. Removal of all trash would take > 2 hours. • Approximately >2 times more trash than the high condition category
Site Score	**1 2 3**	**4 5 6**	**7 8 9**	**10 11 12**

Vegetated Condition Assessment

▶ **Below, Estimate the Proportion (%) of the total area of <u>combined banks within the Assessment Area</u> (including vegetated islands if present) that contains the following cover types:**

Ground Cover (e.g., grasses/weeds < 2ft in height)	**Understory** (e.g., bushes, poison oak, blackberries, small trees 2-10ft in height)	**Trees/Roots/Wood** (e.g., living trees/roots along toe of bank, other natural woody debris material)	**Bare Ground** (e.g., soil, concrete and other bank armoring material)	**Total**
_____ %	_____ %	_____ %	_____ %	**100%**

▶ **Below, Estimate the Proportion (%) of the total area of <u>channel within the Assessment Area</u> that contains the following cover types:**

Woody Debris (e.g., logs, sticks, branches, and other natural woody material)	**Aquatic Vegetation** (e.g., grasses, rushes, sedges, water cress, water lily)	**Algae** (e.g., filamentous or floating algal mat)	**No Vegetation or Woody Debris** (e.g., water surface, dry bed)	**Total**
_____ %	_____ %	_____ %	_____ %	**100%**

Comments on Vegetated Condition:

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

Pathway Analysis

▶ **Below, estimate the contribution (%) by volume associated with each pathway below. Use increments of 10%. The percentages for the four categories should add up to 100%. See Table 2 in Trash Assessment SOP for guidance in selecting trash items for each pathway.**

% Contribution of Trash to Assessment Area (10% increments)

Litter/Wind	Illegal Encampment	Illegal Dumping	Other/Unknown (e.g., Stormwater and Unknown Upstream Sources)	Total
_____ %	_____ %	_____ %	_____ %	100%

Photo Documentation

▶ **Take photographs (looking upstream) at three segments (A, B and C) for typical 300 foot trash assessment area. Additional segments will be photographed for longer sites (e.g., shoreline sites).**

Note: When conducting quantitative monitoring, do not complete this section, rather record photo documentation under Section III (Quantitative Monitoring).

Segment	Photograph ID	Segment	Photograph ID
A		D	
B		E	
C		F	

Comments for Qualitative Assessment

Description of trash sources observed in land areas adjacent to the assessment area

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

Image/Sketch/Diagram of Site

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

III. Quantitative Trash Monitoring

Site ID

Estimated Volume of Trash Removed

▶ **Record total volume of trash associated with each trash pathway that was collected in the assessment area. For small items collected in buckets or bags, use 0.5 gal increments. For large (unbagged) items, use 0.5 ft^3 or yd^3 increments.**

Trash Pathway	Trash Volume (Un-compacted)					
	Small (bagged) Items[1]				Large (Unbagged) Items[2]	
	# Buckets	Bucket Size (gal)	# Bags	Bag Size (gal)	Volume	Unit (circle)
Litter/Wind						
Illegal Encampment						ft^3 yd^3
Illegal Dumping						ft^3 yd^3
Unknown (e.g., Stormwater, or Unknown Upstream Sources)						
Total Trash (Sum of the above rows)						ft^3 yd^3

[1] Small items may include: Food Wrappers, Takeout Food Containers and Utensils, Glass and Plastic Bottles, Clothing/Shoes, Sports Balls, Spray Paint Cans, Small Styrofoam Aluminum, Steel, and Tin Cans, Cigarette Butts, Single Use Plastic Bags, Small Automotive Related Items, Biohazards (Syringes, Diapers, Human Waste, Pet Waste), Paper Products, Cardboard

[2] Shopping Carts, Mattresses, Coolers, Furniture, Appliances, Tires, Bicycles, Construction Debris, Automobile Parts and Large Bags of Trash

Most Prevalent Trash Items Observed (Top 5)

▶ **Circle the <u>five</u> most prevalent trash items observed at the site.**

Plastic	Glass/Metal/Fabric	Construction/Auto Debris	Large Household Items	Toxic Substances
Single Use Plastic Carryout Bags	Aluminum cans	Metal material	Mattresses	Cigarette butts
Convenience/Fast Food items	Fabric and cloth	Wood material/debris	Furniture	Spray paint cans
Beverage Bottles	Paper and cardboard	Tires	Appliances	Biohazards (Used needles, diapers, human waste)
Polystyrene (Styrofoam)	Broken glass	Asphalt/concrete/bricks	Bicycles	Used oil
Other plastic	Shopping carts	Car parts		
Other:				

Receiving Water Trash Assessment Data Collection Form (Version 1.0)

Photo Documentation

▶ Photographs are taken before trash removal and after trash removal at three segments (A, B and C) for typical 300 foot trash assessment area. Additional segments will be photographed for longer sites (e.g., trash hot spots at shorelines).

Segment	Photograph ID	
	Pre-removal	Post-removal
A		
B		
C		
D		
E		
F		

Resources and Time Expended

▶ Total # of field crew members involved in the quantitative monitoring event: _____

▶ Total # of person hours expended in the field conducting the quantitative monitoring event: _____

Comments for Quantitative Monitoring

ATTACHMENT 3

GUIDANCE FOR ASSESSING TRASH CONDITION

June 2017

LOW TRASH LEVEL CONDITION

Effectively no or very little trash. On first glance, little or no trash is visible. Little or no trash is evident when streambed and stream banks are closely examined for litter and debris. One individual could easily remove all trash observed within 30 minutes

June 2017

June 2017

MODERATE TRASH LEVEL CONDITION

Predominantly free of trash except for a few littered areas. On first glance, trash is evident in low levels. After close inspection, small levels of trash are evident in stream bank and/or streambed. On average, all trash could be cleaned up by two individuals within 30 minutes to one hour. Approximately 2-3 times more trash than the low condition category

June 2017

June 2017

HIGH TRASH LEVEL CONDITION

Predominantly littered except for a few clean areas. Trash is evident upon first glance in moderate levels along streambed and banks. Evidence of site being used by people: scattered cans, bottles, food wrappers, plastic bags, etc. On average, would take a more organized effort (more than 2 people, but less than 5) to remove all trash from the area. Removal of trash would take 30 mins to 2 hours. Approximately 2-6 times more trash than the moderate condition category

June 2017

June 2017

VERY HIGH TRASH LEVEL CONDITION

Trash is continuously seen throughout the assessment area. Trash distracts the eye on first glance. Substantial levels of litter and debris in streambed and banks. Evidence of site being used frequently by people (e.g., many cans, bottles, food wrappers, plastic bags, clothing; piles of garbage and debris). On average, would take a large number of people (more than 5) during an organized effort to remove all trash from the area. Removal of all trash would take more than 2 hours. Approximately 2 or more times trash than the high condition category

June 2017

June 2017

Attachment 8

Stakeholder and Peer Reviewer Comments Received and Responses

BASMAA Receiving Water Trash Monitoring Program Plan

Response to Peer Reviewer Comments

May 30, 2017

General Comments

Peer Reviewer	General Comments	BASMAA"s Response to Comments
Shelly Moore (SCCWRP)	As the State Water Board, Regional Water Boards, stormwater agencies, other municipalities and citizen monitoring groups look to develop methods to determine if their efforts in lessening the amount of trash in the environment are being effective, the need for comparable monitoring on both temporal and spatial levels becomes critical. I commend BASMAA for being proactive in looking for ways to meet this need. My three general suggestions are:	Thank you for your comment.
Shelly Moore (SCCWRP)	1. Recommend that users develop a set of scientific questions relative to the management questions for users to use as a focus. This will help the users understand how their efforts will relate directly back to the larger management questions. Example: Management question: Have a Permittee's trash control actions effectively prevented trash within a Permittee's jurisdiction from discharging into receiving waters? (Has the amount of trash in the river/creek decreased over time?) Scientific question 1: Are we 95% certain that we have a decline in at least 10% in the last year in the volume of overall trash found in rivers/streams? Scientific monitoring question 2: Are we 90% sure that the trash levels in visual assessments have decreased by one category during the last two years?	Thank you for the suggestion. To the extent possible, more defined scientific monitoring questions will be developed and incorporated into the next draft of the document.
Shelly Moore (SCCWRP)	2. Provide guidance on data analysis of the trash data both on local and regional levels. The section on relating trash levels to other factors such as watershed area, steam orders, etc. is great. I would recommend also adding some direct examples of how to analyze the data collected directly from the trash surveys and how to relate those analyses to answering the management questions.	Section 6 will be renamed "Data Management, Analysis and Interpretation." If time permits, we'll added a couple of examples (text and graphs/tables) of the types of analyses that are recommended to answer the scientific monitoring questions and inform the management questions.
Shelly Moore (SCCWRP)	3. Reformat the document to include Attachment 7 in main document as well as move any figures that are currently within attachments to the main document to enhance understanding of the protocols.	From our experience in developing monitoring plans and protocols, field staff typically want a standalone standard operating procedure (SOP) for conducting field work to allow them to take the SOP into the field. For this reason, we'd prefer to keep the SOP as an Attachments. We'll review the main body of the Plan and add SOP elements to better allow the reader to understand the extent of the protocol.
Dr. Sherry Lippiatt (NOAA)	I think it's important to consider messaging of the results and packaging of the data to share with the public. How will the results provide a holistic assessment of how trash is changing regionally or in each permittee's jurisdiction? Could you include an example of the primary figure or data visualization you see coming out of this pilot monitoring effort? How can you message benefits to the community e.g. through increased recreational opportunities at cleaner sites?	Section 6 will be renamed "Data Management, Analysis and Interpretation." If time permits, we'll added a couple of examples (text and graphs/tables) of the types of analyses that are recommended to answer the scientific monitoring questions and inform the management questions. Additional discussion of how the information will be provided to stakeholders and interested parties will also be included.
Dr. Sherry Lippiatt (NOAA)	Under project planning in the SOPs it might be helpful to provide an estimate of the amount of time required per qualitative and quantitative assessment.	As suggested, an estimate of the time required to perform a qualitative, quantitative and both protocols will be added to Section 7.0.
Dr. Sherry Lippiatt (NOAA)	2 minor changes to my bio – in this context please refer to me as Dr. Lippiatt. I'm the Regional Coordinator for all of California not just the Bay Area. Thanks!	We apologize for the errors in the bio. Both revisions will be made.

1. Is the Trash Monitoring Program designed (i.e., sampling design, timing and frequency) to successfully address the MRP management questions during the pilot-testing phase of the Program? If not, provide recommendations to improve the likelihood of its success.		
Peer Reviewer	**Peer Reviewer Responses to Focused Questions**	**BASMAA"s Response to Comments**
Shelly Moore (SCCWRP)	I believe the Trash Monitoring Program is designed to successfully address the MRP management questions. The only comment I have regarding the sampling design is the decision to only do quantitative analysis at targeted sites (hot spots). I would recommend this type of analysis at a subset of the probabilistic sites as well. As we move forward towards determining if visual assessments are effective enough alone to determine change, it would be useful to have comparisons on sites with a variety of levels of trash.	Based on an evaluation of data collected over the past 5 years at over 300 sites, trash levels at targeted (hot spots) varying substantially between sites. Therefore, we anticipate that the 100 sites selected for conducting both qualitative assessments and quantitative monitoring will provide a range of trash levels to adequately evaluate the relationship between the two protocols. Additional guidance will be provided to Permittees, however, before the subset of hot spots are selected for inclusion in the pilot-testing phase to further insure that the 100 sites will provide a range of trash levels. For these reasons, we believe that adding quantitative monitoring to probabilistic sites is not necessary to test the whether visual assessments are effective enough alone as a protocol.
Shelly Moore (SCCWRP)	I would also recommend adding information on size of trash to the document (i.e. is > 5 mm the target or is it larger/smaller items). Since the actual trash items in the quantitative surveys are not being categorized by type it might be good to estimate the relative percent of volume of the major categories of trash (plastic, metal, wood, etc.).	Trash items observed in receiving waters have wide ranges in size. To provide a better understanding of the types and sizes of trash observed, the top five predominate types of trash observed will be added to the field data sheets.
Dr. Aroon Melwani (Applied Marine Sciences)	My main comment on the design is the utility of only a qualitative assessment of probabilistic sites, in pilot testing phase. In the current approach, you would only be able to assess representativeness and ambient condition using overall condition score (right?), and will not have any information on the ambient conditions relative to specific metrics, which I think is a priority to be able to address MRP questions of transport to receiving waters and adverse impacts.	Based on an evaluation of data collected over the past 5 years at over 300 sites, trash levels at targeted (hot spots) varying substantially between sites. Therefore, we anticipate that the 100 sites selected for conducting both qualitative assessments and quantitative monitoring will provide a range of trash levels to adequately evaluate the relationship between the two protocols. Additional guidance will be provided to Permittees, however, before the subset of hot spots are selected for inclusion in the pilot-testing phase to further insure that the 100 sites will provide a range of trash levels. For these reasons, we believe that adding quantitative monitoring to probabilistic sites is not necessary to test the whether visual assessments are effective enough alone as a protocol.
Dr. Aroon Melwani (Applied Marine Sciences)	Another important question not clearly articulated is the integration of the hot spot (targeted) sites with the probabilistic data. One way to gauge the performance at hot spots would be to place it on the scale of ambient. That has not been described in the design or interpretative sections (again addressing the MRP question related to adverse impacts).	Consistent with the reviewer's suggestion, the types of analyses of hot spots that has been discussed by the PMT is to relate each site to the scale of trash at ambient sites. A more detailed description of the recommended manner in which this analysis should be done, will be discussed in Section 3.2 and included in Section 6, now renamed "Data Management, Analysis and Interpretation."
Dr. Aroon Melwani (Applied Marine Sciences)	For background to the design, it would have been helpful to describe in more detail how the RMC sample design was developed, and questions it has been used to address.	Additional text will be added to describe in more detail how the RMC sample design was developed and the questions it was designed to answer.

BASMAA Receiving Water Trash Monitoring Program Plan

Response to Peer Reviewer Comments

May 30, 2017

Peer Reviewer	General Comments	BASMAA"s Response to Comments
Dr. Sherry Lippiatt (NOAA)	I agree with the focus on the standing stock of debris deposited and within creeks / channels versus attempting to collect flux measurements. Reducing methodological and safety challenges is good.	Thank you for your comments. We're glad you agree with our approach for the pilot-testing phase.
Dr. Sherry Lippiatt (NOAA)	It makes sense to start with the existing set of RMC Creek Status and Trends sites as potential probabilistic sites.	Thank you for your comments. We're glad you agree with our approach for the pilot-testing phase.
Dr. Sherry Lippiatt (NOAA)	How were the potential Trash Hot Spot sites (Table 3-4) originally selected? I get that these sites are already actively cleaned, but what makes them good candidate monitoring sites?	These sites generally represent an important part of the data distribution that may be under sampled via the probabilistic design. These sites are accessible to field crews and leverage current cleanup activities, which reduced the resources necessary to carry out trash monitoring. Additionally, each Permittee cleans up at least one hot spot within their jurisdiction, so sites are located within a variety of jurisdictions and creek/channels/shorelines. For these reasons, trash hot spots were selected as monitoring sites.
Dr. Sherry Lippiatt (NOAA)	Table 3-1: are the hotspot sites in northern San Mateo County (Fig 3-3) on the coast? If not I wouldn't say that the Pacific Ocean will be assessed by this monitoring plan.	Sites for San Mateo County are located both on the coast- and Bay-sides.
Dr. Sherry Lippiatt (NOAA)	In terms of data management, it sounds like changes need to be made to the CEDEN database, how will the data be stored and backed-up in the meantime? Recommend including a protocol or workflow.	Text will be added to Section 6 to describe QA procedures for backing up and storing data. CEDEN will be updated during the first phase of the Plan, and entered into CEDEN following completion of the pilot-phase.

2. Are the proposed monitoring protocols (qualitative visual and quantitative monitoring) adequately defined to ensure the consistent data collection among users and comparisons across multiple receiving water and discharge scenarios? If not, provide recommendations to improve the collection of standardized data across multiple receiving water and discharge scenarios.		
Peer Reviewer	**Peer Reviewer Responses to Focused Questions**	**BASMAA"s Response to Comments**
Shelly Moore (SCCWRP)	The proposed monitoring protocols could use some refinement to help users better understand the methods. I would recommend moving Attachment 7 into the document as opposed to having it as an attachment and including some pictures within the text (i.e. low, medium, high trash levels).	From our experience in developing monitoring plans and protocols, field staff typically want a standalone standard operating procedure (SOP) for conducting field work to allow them to take the SOP into the field. For this reason, we'd prefer to keep the SOP as an Attachments. We'll review the main body of the Plan and add SOP elements to better allow the reader to understand the extent of the protocol.
Shelly Moore (SCCWRP)	I would also recommend having some examples of filled out forms and data as entered into an electronic template (as attachments). The more consistent information, examples and tools you can provide the user the better.	We'll added example completed field forms to Attachment 7.
Shelly Moore (SCCWRP)	Creation of electronic data entry templates would enhance the comparability as well. Simple applications for common mobile devices are easy and relatively cheap to create these days.	We agree that the creation of mobile applications would assist with data standardization and comparability among different users, and likely reduce the resources needed for data entry. That said, the purpose of this phase of the Trash Monitoring Program is to test the protocols and refine them based on lessons learned during this phase. Therefore, from a timing standpoint, the development of mobile applications should likely wait until after the pilot-testing phase is complete, and the data collection form and protocol is finalized.
Dr. Aroon Melwani (Applied Marine Sciences)	Trash protocols are not an area of my expertise, however, the protocols appear well founded and closely relate to what has successfully been employed in portions of the Bay Area previously. The added metric of vegetation cover to the assessment is a highly suitable addition.	Thank you for your comment.
Dr. Sherry Lippiatt (NOAA)	Is a separate qualitative and/or quantitative assessment completed for each 100 ft segment of the 300 of 600 ft site? It didn't seem so until I got to pg 22 under the "completeness" section. I think it's a good idea to subsample, and I'd recommend at least doing separate qualitative assessments, and revising the datasheet to make space for different scores in each segment.	The PMT discussed the idea prior to the development of the Draft Protocol, but ended up shying away from getting separate qualitative assessment scores for each 100 ft length. The reasoning was that it would be logistically challenging for field crews to clearly delineate 100 ft sections and reliably collect both qualitative and quantitative data within those lengths. Additionally, it would add effort that during the data analysis stage would not necessarily assist with one of the goals, to compare the qualitative scores to quantitative data. For these reasons, the PMT decided to not include separate data collection at 100 ft lengths.
Dr. Sherry Lippiatt (NOAA)	I understand the need to compromise and limit the amount of information collected in the field based on limited resources, but I have some thoughts on the focus on trash volume in quantitative surveys versus counts / characterizing the trash types:	See responses below.

BASMAA Receiving Water Trash Monitoring Program Plan

Response to Peer Reviewer Comments

May 30, 2017

Peer Reviewer	General Comments	BASMAA"s Response to Comments
Dr. Sherry Lippiatt (NOAA)	A. (footnote page 17): I disagree that there is no direct link between types and MRP questions. The trash management questions posed in MRP 2.0 to me seem to be focused on the amount and sources of trash. The goal is to assess whether the trash control actions are effective at preventing trash from entering receiving waters, and determine the other sources of trash to receiving waters. If you want to identify the source of trash, you need to know more than the amount present, you need to know what it is. Even the quantitative method outlined here relies on characterizing the trash to assess the source.	There is a distinction between "source" and "pathway" that is not always clear. Sources includes littering, uncovered trucks, illegal dumping, overflowing containers, spills via garbage trucks, etc. Pathways include wind, illegal (direct) dumping and stormwater conveyance systems (i.e., storm drains). The protocol is intended to address management questions focused on pathways, not sources. Therefore, the volumes of trash estimated to be contributed via each pathway is the primary data need, not the type or brand of trash, which we agree may help identify sources, but is too fine of a resolution needed to identify pathways.
Dr. Sherry Lippiatt (NOAA)	B. In Attachment 2 of the document, under the section “Refinement of Existing Monitoring Tools”, it states that “Volume may be a more meaningful measurement for assessing impacts”. Again I think the MRP questions are more focused on sources than impacts. Even so, I don’t agree with this statement. Consider the relative impact (or risk posed to wildlife) of one trash bag or bucket-sized item compared to an entire trash-bag or bucket full of smaller plastic items.	We agree that smaller, transportable/ingestible items are likely the most important from a trash impact standpoint, specifically if the impact is associated with wildlife/fish habitat. That said, large items can degrade and do cause other aesthetic-related impacts to waterways. Volumes were chosen because they have been the most repeatable measurement during previous studies, and they generally indicate the "amount" of trash present and causing an aesthetic impact. Additionally, the Regional Water Board staff have repeatedly expressed an interest in trash volumes, as opposed to item counts or weights.
Dr. Sherry Lippiatt (NOAA)	C. Item types would also help assess transport from one receiving water body to the next	Item types would help assess the "transportability" aspect of trash observed, but as indicated in the Plan, the management question is not the priority for the pilot-testing phase of the Plan. That said, to provide a better understanding of the types and sizes of trash observed, the top five predominate types of trash observed will be added to the field data sheets.
Dr. Sherry Lippiatt (NOAA)	D. Would it be possible to do post-survey characterization of collected trash (perhaps by different volunteers)? Or is this stormwater debris too degraded to characterize after the fact?	It would be possible, however, based on the numerous trash characterization studies that we've conducted in the Bay area, the use of this information is limited to either characterize the pathway, which is the primary driver of the monitoring. That said, to provide a better understanding of the types and sizes of trash observed, the top five predominate types of trash observed will be added to the field data sheets.
Dr. Sherry Lippiatt (NOAA)	E. Based on the language on pg 13 it sounds like the permittees are already collecting trash type information at hot spots, is this accurate?	E. Permittees are currently identifying the major trash sources or pathways observed, and the types of items collected. They are generally not collecting percentages, volumes or item counts at hot spots. The language in the Plan will be revised, as needed, to make this clearer.
Dr. Sherry Lippiatt (NOAA)	F. Overall I wonder whether there is interest / willingness from the permittees in counting and/or characterizing debris. If there is significant interest it would be great to provide stronger recommendations for what protocols they should follow.	Many Permittees and Programs have conducted trash characterization in the past. Some Permittees have shown some interest in continuing to characterize trash. Protocols, however, are not well defined and are generally developed on a project specific basis. We reference a couple of studies that have been conducted in the Bay Area to point Permittees to example protocols.

BASMAA Receiving Water Trash Monitoring Program Plan

Response to Peer Reviewer Comments

May 30, 2017

Peer Reviewer	General Comments	BASMAA"s Response to Comments
Dr. Sherry Lippiatt (NOAA)	What is reported by existing full capture devices? It would be interesting to compare what's being removed to the amounts in the receiving waters.	There are thousands of full capture devices currently in place in the Bay Area. The amount of trash and/or debris removed via full capture systems is currently not being collected by Permittees, so the comparison is not possible at this time. That said, the amount of trash being discharged via the stormwater conveyance system has been estimated and serves as an important part of the compliance approach in the Bay Area for municipal stormwater. Comparisons could be made between these estimates/data. This example comparison will be included in Section 6, which is now renamed "Data Management, Analysis and Interpretation."
Dr. Sherry Lippiatt (NOAA)	Considerations for engaging volunteers: Some extra work up front can save you time in terms of volunteer retention. Require field training and develop a plan for providing feedback to the volunteers, sharing survey results to increase engagement.	Thank you for your comment. We'll incorporate your suggestion into Section 5.2 "Volunteer Monitoring"
Dr. Sherry Lippiatt (NOAA)	Clarify whether the width of the assessment area is measured by having one person stand on either bank and hold a measuring tape between them? Or is it the bank to bank distance along the ground? This isn't explained very clearly.	The distance is based on the ground, so that we can get "per unit area" measurements. The text will be revised to indicate this and make clearer.
Dr. Sherry Lippiatt (NOAA)	Qualitative Trash monitoring: A. For qualitative trash assessment category photos, it would be helpful to annotate the photos. It's hard to tell the difference between trash and natural debris in many of the pictures when they are printed out. B. Did you consider using a % cover estimation for trash condition category? This is an accepted method for shoreline assessment after oil spills (http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/shoreline-cleanup-and-assessment-technique-scat.html)	Your suggestion of percent cover is an interesting one that we will consider in subsequent phases. For the pilot phase, however, the PMT decided that estimating the percent cover too challenging to implement at this time.
Dr. Sherry Lippiatt (NOAA)	Estimating % contribution by volume of different sources: A. The table reference in the datasheet may be wrong, it's table 2 in my version of the SOPs. B. This seems very subjective, which I think should be acknowledged in the document for the sake of survey teams worried about how to determine different %es. C. Consider limiting it to one significant digit (i.e. 10%, 20%, etc). How can someone reliably tell the difference between 33% and 34% homeless debris?	A. The Table # will be revised. B. This part of the protocol will be difficult to conduct and will likely be somewhat subjective. Once trash is in the water way, it's difficult to ascertain its origin at times. Text will be updated to indicate as such. C. Good suggestion. We will revise to one significant figure.

BASMAA Receiving Water Trash Monitoring Program Plan

Response to Peer Reviewer Comments

May 30, 2017

Peer Reviewer	General Comments	BASMAA"s Response to Comments
Dr. Sherry Lippiatt (NOAA)	On SOP Table 2: A. I'd suggest putting the example trash items column last, given that there's so much overlap that in many cases it's the least helpful to determining which pathway is most prevalent. B. Illegal dumping: why is yard waste listed? Is that included in the survey? Or just an indication that it's an area where illegal dumping typically occurs? C. Wind: is a "road crossing" the same as a bridge?	A. On Table 2, the example list will be moved to the last column. B. Yard waste was listed as an "indicator" of illegal dumping, but will not itself be considered trash. C. Yes, road crossing is the same as a bridge.
Dr. Sherry Lippiatt (NOAA)	Photo Documentation (SOP section 5.3): A. Add a reminder on the datasheet that photos are taken looking upstream. B. How is the orientation of photos determined for Bay shoreline sites? (I'd assume it's looking toward point A?). C. Specify where on the datasheet additional optional photo ID #s should be listed, and that they should be attributed to a specific segment.	The SOP section 5.3 will be revised to incorporate the suggestions.
Dr. Sherry Lippiatt (NOAA)	Quantitative trash monitoring (SOP section 6): A. "the outside of the buckets should be marked" – with what? B. Should the collection start in the waterway and move progressively toward the banks? i.e. start with the stormwater debris? Additional guidance on this would be helpful for survey teams. C. See comments above regarding item characterization vs volume.	A. Text will be revised to indicate that the bucket should be marked with a permanent marker. B. Trash from the stormwater pathway is not necessarily the only type of trash in the water, and is not only found in the water. Additional guidance will be added to make sure that it's clear to user that being systematic about the pathway collection is important to the process. Providing flexibility in the order to which each pathway is evaluated, however, is important at this stage to allow the users to develop efficient and practical practices to share with others via the lessons learned stage that will follow pilot-testing and prior to revising the protocols tested.
Dr. Sherry Lippiatt (NOAA)	Datasheet: A. Suggest moving the photo documentation section currently in section I on page 1 to section II. My understanding is that the first photo section is filled out only for probabilistic sites (qualitative survey only), so why not put it in the qualitative section. Additionally that way the entire vegetation condition section could be on the 1st page of the datasheet. B. Quantitative monitoring volumes table: - What is recorded in the "Large (unbagged) Items" column? Is this a list of the individual items and their volumes? - Is the Units column to the right only intended for the large items? The others should all be in gallons. If so I'd shade both of them a different color gray to indicate they go together. - Why is there a units option for wind driven items if there are no large items allowed for that pathway?	A. Good suggestion. We will rearrange as suggested. B. Large items = volumes, not items B. Units - Good suggestion. All but large items will be in gallons. The box for large items and the wind pathway will be shaded, implying that there are no "wind" affected large items.

3. Is the proposed protocol on how to best define an assessment area (i.e., where trash assessment and monitoring will occur) clear, practical to implement, and repeatable? If not, provide recommendations to improve.		
Peer Reviewer	**Peer Reviewer Responses to Focused Questions**	**BASMAA"s Response to Comments**
Shelly Moore (SCCWRP)	Yes, the definition of the assessment area is clear. I would recommend moving the pictures to within the text and not having them as an attachment. I think the top down pictures are the best (such as the one used for the beach example) and better to show the scale of the assessment area.	Top down pictures will be included in the main body of the Plan.
Dr. Aroon Melwani (Applied Marine Sciences)	The proposed protocols were well described for the assessment approach. I did not find as much information provided on how to determine whether the probabilistic sites are suitable for being assessed (ie access, safety, etc.), and the list of criteria that make a site suitable. This should be added to provide a consistent manner to the site evaluations.	Additional text will be added to describe in more detail how the RMC sample design was developed and the questions it was designed to answer. Additionally, criteria on the evaluation of the sites will be better described in the text.
Dr. Sherry Lippiatt (NOAA)	A. Are the GPS locations provided in Attachment 6 the downstream boundary (A)? B. How is the up or down-stream direction determined for bay shoreline sites?	A. These are the downstream boundary of the site. Text will be added to make this clear. B. The downstream and upstream direction is user defined. Text will be added to indicate that the up and downstream ends should be consistently defined between monitoring events.

4. Are quality control procedures well stated and adequate for the validation of data collected during the pilot-testing phase? If not, provide recommendations to improve.		
Peer Reviewer	**Peer Reviewer Responses to Focused Questions**	**BASMAA"s Response to Comments**
Shelly Moore (SCCWRP)	I would recommend adding a component to the quantitative protocol that calls for a subset of sites to be assessed after trash removal has taken place. This would require that a person or persons not involved with the initial survey visit the site shortly after it has been sampled to determine if all trash was removed and measured. In our study, here in southern California of trash in rivers and streams, we found that crews had varying levels of quality with respect to collecting and enumerating the trash. It would be good to know how well crews are doing in general.	We agree that making sure that it is very important to verify that the vast majority of trash has been removed from a site during a quantitative monitoring event. QA components that will be added include the requirement that a "field coordinator" check the site to make sure that trash has been adequately removed and measured, and the requirement to take "after the cleanup event" photos to demonstrate the level of cleanup that has occurred.
Dr. Aroon Melwani (Applied Marine Sciences)	The proposed QA/QC procedures appear to be appropriate for the validation of data. There is mention of inter-rater comparability, would like to see what quantitative measures are being considered to assess this.	We'll add a description of the inter-rater comparability metric that will be used.
Dr. Sherry Lippiatt (NOAA)	Pg. 23, Precision: Where are trash volumes (and weights?) re-analyzed - in the field or elsewhere? How and where are the values recorded and reported, to assess % difference and need for additional training? Some of the re-analysis variability is based on detection of trash in the site, so if items are collected by the first surveyor you can't account for all of the variability between different surveyors.	Trash volumes are reanalyzed in the field. Different individuals will estimate volumes and relative percent differences will be calculated and training applied should results be greater than measurement quality objectives. Weights are not being measured.
Dr. Sherry Lippiatt (NOAA)	I'd recommend emphasizing accurate reporting of how many surveyors are present as well as the crew member names on the datasheet (create more space for that field). Add more specific in terms of whether to count a crew member who may be present but not actively contributing to the survey or looking for trash in quantitative surveys. We've found that in our NOAA shoreline surveys, when more volunteers are present more debris is found, even though the survey area remains constant (it may be that more volunteers are directed to dirtier sites, but still a confounding finding and maybe due to some kind of pressure to find all the trash when other people are "watching").	Agreed. We'll revise to emphasize the number and names of surveyors and crew members.
Dr. Sherry Lippiatt (NOAA)	I'd require a field training for volunteers (this isn't explicitly stated).	Agreed. This was the intent, but we'll make it more explicit.
Dr. Sherry Lippiatt (NOAA)	Does the Field Crew Supervisor need to be a paid employee, or can it be another volunteer?	Either is fine, as long as they've gone through the training.
Dr. Sherry Lippiatt (NOAA)	Are the data management QA/QC considerations (page 25) requirements or just considerations?	These are quality assurance measurement quality objectives that are intended to be followed.

Response to Stakeholder Comments on Draft Receiving Water Trash Monitoring Program Plan (May 30, 2017)

Section	Stakeholder	Comment	BASMAA's Response to Comments
General	Cities of Concord and San Pablo	Why are Permittees sampling 100 Targeted sites? This is 50% of all targeted sites. Again this seems to be excessive monitoring for statistical analysis, especially for a pilot program.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. Subsequently, this number of sites was presented to the Peer Reviewers in the Draft Plan. Reducing the number of sites now would undermine previous agreements and the Peer Review process. Additionally, the number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. The number of sites proposed is consistent with the goals of the pilot-phase. If the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring.
General	City of Pittsburg	Also, question 5 from tables 2-3 and 3-3 isn't even in the permit why was this added?	Question #5, as described in the footnote, was broken out separately from a broader question posed in the MRP to allow a specific design to link to the question.
General	City of Pittsburg	Section 2.3, in general I thought the overall goal is to just get the answers to the 5 receiving water monitoring questions. There are eight goals listed in this paragraph that don't clearly indicate how they correlate to the required questions we need answered. For example what goal listed on page 7 correlates to Questions 4 and 5: determining if there are sources outside of the permittees jurisdiction causing or contributing to adverse trash impacts, and if trash is present is it being transported from one receiving water to another, at levels that may cause adverse water quality impacts? To answer these questions, we would need to have an understanding of the drainage pathways in any given monitored area for the analysis to be complete.	The goal of the Monitoring Program Plan is to begin to address the Management Questions posed in the MRP. The PMT created the broader goals as a way to create a broader context and framework for the monitoring, and incorporate the concepts included in the MRP Factsheet.
General	City of Richmond	Sampling locations for probabilistic sites are excessive for a pilot testing phase, especially when it is not determined whether the data will be analyzed on regional or county wide levels.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. The number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. The decision for Programs to "join together" and reduce the number of sites needed has not been made. Therefore, we assumed the each of the four County stormwater programs would conduct and analyze their data separately. Given this assumption, if the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring. With regard to the level of effort currently employed for creek status monitoring, the number of sites needed to adequately characterize the range of creeks/channels in each county is assumed to be 30 sites, as described in the RMC Monitoring Plan. Therefore, the 30 site threshold is consistent with the proposed level of effort included in the Trash Monitoring Program Plan.
General	City of Richmond	It would be difficult to determine contribution of trash by different pathways if not witnessed at specific time and place (temporal and special), especially for light-weighted items, thus collected data could be skewed in data analysis and interpretation.	We agree this will be challenging. Additional discussion was added to the plan regarding the very challenging (possibly impossible) process of identifying specific pathways and the relative percentage of trash observed from each. Additionally, the categories were changed to the following: illegal encampments, illegal dumping, litter/wind and other/unknown (e.g., upstream sources and stormwater).

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General	City of San Pablo	Since there is limited certainty regarding trash pathways it is suggested to change the transport pathways to: o Encampments (use current characteristics described in plan to determine) o Illegal dumping (use current characteristics described in plan to determine) o Wind (use current characteristics described in plan to determine) o Other/Unknown (any other method that could not be determined with any certainty and could be transported via stormwater, wind, directly deposited etc.)	Based on the commenters suggestions, we are revising the categories to the following: illegal encampments, illegal dumping, litter/wind, and other/unknown (e.g., upstream sources and stormwater).
General	City of San Pablo	Regarding the comment to only determine the pathways in increments of 10%- How are we determining this (volume or by number). I am concerned that by either method the number associated with certain pathways (i.e. wind and or Stormdrain/Other) will always be 0% because of the volume that pathways such as encampments and/or direct dumping will present. I think we should be able to determine in increments of 5%.	Based on the commenters suggestions, we are revising the categories to the following: illegal encampments, illegal dumping, litter/wind, and other/unknown (e.g., upstream sources and stormwater). Percentages associated with each will be associated with volumes observed/estimated. Consistent with the Peer Reviewer comments, we believe that 10% increments will be the resolution that can be observed during the qualitative assessments. Contributions from each pathway documented via quantitative monitoring will be based on gross volume estimates/measurements.
General	Contra Costa Clean Water Program (CCCWP)	A recommendation that a section be added to the Plan on future monitoring efforts after the pilot monitoring phase. If the sample size cannot be reduced during the pilot phase, given the fact that the draft Plan has already been subject to peer review, add language to the Plan recognizing that this initial monitoring effort is robust and may not be necessary in the future; the number of sites to be sampled in the future will be re-evaluated based on upon monitoring results; this evaluation may result in a reduction of sites that need to be monitored.	Additional text was added as suggested.
General	Contra Costa Clean Water Program (CCCWP)	A recommendation to lower the total number of monitoring sites, especially the 30 probabilistic sites which will take significant consultant and staff time to obtain the necessary permissions.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. Subsequently, this number of sites was presented to the Peer Reviewers in the Draft Plan. Reducing the number of sites now would undermine previous agreements and the Peer Review process. Additionally, the number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. If the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring.
General	Contra Costa Clean Water Program (CCCWP)	A clarification on why this pilot study has such a robust sampling plan when typically pilot studies are more limited in scope. The number of sites to be monitored should be the minimum necessary to satisfy specific statistical requirements and adequately answer the management questions being asked.	The monitoring design agreed to by the PMT at their May 1, 2017 meeting, and reviewed by Peer Reviewers represents a pilot-scale implementation level. Site locations and methods are focused on only high priority water body types and components, and the temporal and spatial scale is consistent with monitoring goals and management questions posed in the MRP. Additionally, the number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. If the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring.
General	Contra Costa Clean Water Program (CCCWP)	A recommendation to clearly express that estimations of relative contributions from the four trash pathways is speculative and cannot be definitively determined.	Yes. Additional discussion was added to the plan regarding the very challenging (possibly impossible) process of identifying specific pathways and the relative percentage of trash observed from each. Additionally, the categories will be changed to the following: illegal encampments, illegal dumping, litter and other (e.g., upstream sources, stormwater and wind).

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Section	Stakeholder	Comment	BASMAA's Response to Comments
General	Contra Costa County	I am concerned about the number of sample sites. For a pilot project, it seems that there would be fraction of the sample sites. To have statistically significant results, counties could potentially work on this together, e.g. Alameda and Contra Costa County. For urban creek sampling, only 10 bioassessment sites are monitored annually for Contra Costa County, as opposed to 30 qualitative and 19 quantitative sampling sites for Contra Costa County alone. In another study for PCBS, the infrastructure caulk samples, 20 composite samples are being analyzed region-wide, as opposed to trash where 125 random sites and 100 targeted sites; 825 qualitative and 200 quantitative over the course of the study.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. The number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. The decision for Programs to "join together" and reduce the number of sites needed has not been made. Therefore, we assumed the each of the four County stormwater programs would conduct and analyze their data separately. Given this assumption, if the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring. With regard to the level of effort currently employed for creek status monitoring, the number of sites needed to adequately characterize the range of creeks/channels in each county is assumed to be 30 sites, as described in the RMC Monitoring Plan. Therefore, the 30 site threshold is consistent with the proposed level of effort included in the Trash Monitoring Program Plan.
General	Contra Costa County	The final reports and information on CEDEN could present information that will be public and may leave municipalities vulnerable to law suits. The information gathered in the study can be variable based on many factors and should be qualified as such when reporting.	Standard procedures on how to conduct QA analyses and data entry for other types of water quality data have been developed by BASMAA and will be referenced in the Plan. Additionally, since the data are "pilot", the requirement to flag all data as "provisional" will also be added to the data management section.
General	Ocean Protection Council	Thank you for providing the BASMAA Trash Monitoring Program Plan to stakeholders for review. I realize that BASMAA's stormwater agency members have concerns about the number of sites proposed for sampling and qualitative evaluation. I would encourage BASMAA to ensure that an appropriate number of sites are sampled as part of the program to represent of the range of flowing waterbodies in the area. Conducting monitoring at too few sites will reduce our level of certainty in the monitoring results, and would also reduce the usefulness of the project.	The recommendation is the keep the 125 probabilistic and 100 target sites partially for the reason provided by the commenter.
General	Ocean Protection Council	I am not able to comment on whether a county or region-wide approach is most appropriate for this project when determining how many sites are needed to be representative. However, I would encourage BASMAA staff to work with the San Francisco Bay Regional Water Quality Control Board to see which approach to pursue for determining the "representativeness" of the sites.	The recommendation is the keep the 125 probabilistic and 100 target sites partially for the reason provided by the commenter.
General	Santa Clara Valley Water District	Overall, well organized plan. The new scientific monitoring questions are very clear. Something that might help as we all approve first County, then BASMAA level is some of the decisions that need to be made for implementation should be described in a cover letter and whether they would impact the time expended. For example, how will implementation be organized: BASMAA, County programs, permittees? What are the roles and responsibilities? Does that affect number of sites? Since Water Board staff commented that the question is about "permittees", is it even a possibility to go Bay-wide/regional [with interpretation/reporting].	Suggested next steps and decisions that will need to be made will be outlined in a short memo to the PMT. The budget and scope does not include an analysis of the advantages and disadvantages of each, however, and therefore will not be included.
General	SF Bay Regional Water Board Staff	We require more time to study your proposed timing and frequency, and how you will account for antecedent conditions at monitoring sites, including prior cleanups, weather and vegetation condition, maintenance and vegetation changes from year to year.	We appreciate any constructive feedback that can be provided by Water Board staff.

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Section	Stakeholder	Comment	BASMAA's Response to Comments
General	Save the Bay	Save The Bay views the Draft Receiving Water Trash Monitoring Program Plan for the San Francisco Bay Region (Version 1.0) as an important step to better understanding the conveyance of trash into the Bay and its tributaries. It is hoped that the peer-reviewed study, when implemented, will provide important information that will allow for better informed program and policy decisions going forward. Most importantly, a better understanding of the relative contributions of all of the conveyances of trash in the watershed will help in the development of future iterations of the MRP and will allow permittees and all stakeholders to respond to the region's trash problem in a more accurate and nuanced manner.	BASMAA member agencies agree that the RW Trash Monitoring Program Plan is intended to generate data to better understand the levels of trash observed in receiving water bodies and the relative contributions from different pathways. As described by many commenters and discussed at the June 12th Stakeholder Meeting, however, distinguishing pathways is very challenging and may not provide the resolution in data needed to accurately describe these contributions. Trash observed in water bodies cannot always be binned into a pathway based on its characteristics, type, size or condition. With that constraint in mind, the results generated via trash monitoring in the pilot-phase should be considered preliminary and may not be depictive of the contributions from different sources.
General	Save the Bay	As Table 3-4 illustrates, BASMAA is proposing 125 total probabilistic creek, channel and riverine sites in the five county area. Thirty locations to be randomly selected in Alameda, Contra Costa, San Mateo, and Santa Clara Counties respectively. Save the Bay supports this conclusion in the peer reviewed plan. The number of locations proposed by the plan will produce a data set that will be statistically valid and defendable. A robust data set is necessary for proper program design, implementation and evaluation. Any curtailing of the number of monitoring locations will only weaken the statistical strength of the study.	The recommendation is the keep the 125 probabilistic and 100 target sites, partially for the reason provided by the commenter.
General	Save the Bay	Save the Bay agrees with others that evaluating the wind deposition of trash is highly problematic and subject to significant variability. We recommend grouping wind deposition with stormwater as suggested at the June 12 Stakeholder's Meeting. A more appropriate approach for monitoring wind deposition may be to study urban land uses that are being treated with full trash capture devices. A catchment with a full trash capture device(s) will allow for some isolation of the MS4 as the conveyance and allow for more discrete monitoring of the kinds of trash that have a higher probability of being deposited in receiving waters by wind.	Based on the commenters suggestions, we are revising the categories to the following: illegal encampments, illegal dumping, litter/wind, and other/unknown (e.g., upstream sources and stormwater). These are the categories that can most readily be distinguished based on the size, location, type and condition of trash observed. We appreciate the suggestion, but measuring full capture systems is beyond the scope of the Recieving Waters monitoring plan.
General	Save the Bay	Concerns have been raised by some permittees of the logistical and data management difficulties related to monitoring locations where homeless abatement protocols are in place. Other Permittees in the region, such as San Jose, have similar circumstances and have had to develop protocols for achieving the multiple objectives of protection of homeless resident property rights, encampment abatement, heterogeneous waste management, and proper data collection. While these programs often involve multiple agencies, city departments and NGOs, many cities have demonstrated success in these practices. Save The Bay recommends that BASMAA co-permittees devote some time to sharing information and refining proper protocols for managing the logistics of these complex field operations.	To address the concerns and logistics around removing materials associated with illegal encampments, the protocol has been revised. Trash associated with illegal encampments will differentiated using the new procedure included in the protocol: The amount of trash associated with that encampment should be estimated while in the field, left in place, and reported for removal by the appropriate entities using the appropriate methods.
1.1	Cities of Concord and San Pablo	Second Paragraph- If this paragraph is not necessary it should be removed. This makes it sound like Permittees are performing these assessments because of the 303d listings not due to last minute additions to the MRP.	The paragraph is intended to set the context of why trash requirements are included in the MRP. We added text to clarify that the monitoring program is in response to MRP requirements.
1.1	Cities of Concord and San Pablo	Second Paragraph- If this paragraph must be retained, please delete the sentence about results being alarmingly high. Please just provide the facts.	We've revised the sentence to state that the results were reported and described as "very high" by the Regional Water Board.
1.1	Santa Clara Valley Water District	Page 1: first line, "Bay" missing after "San Francisco"	Suggested edit was made.
1.1	Santa Clara Valley Water District	Page 1, end of second paragraph, should it say "watershed areas" instead of watersheds?	Suggested edit was made.
1.2	Cities of Concord and San Pablo	(page 3) Management Questions- Since Permittees were unable to document the potential issues with some of these management questions during the permit process can the consultant please provide discussion in this document with the potential issues and uncertainties of these questions?	We've added text to better describe the challenges with answers these questions.
2.1.3	Pittsburg	Section 2.1.3 the credentials for the peer reviewers should be relocated to an appendix rather than incorporated in the content of the plan. Ok to keep the first and last paragraph.	Peer review of the plan is specifically required by the MRP. By including the credentials of the Peer Reviewers in the text/body of the Plan, it makes it explicitly clear to the reader that the Peer Reviewer are heavily qualified and fulfill the MRP requirement.

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2.3	Cities of Concord and San Pablo	(page 7) - Delete reference to outfall monitoring	The reference to outfall monitoring is consistent with the goals that the PMT developed and were evaluated during the selection of the methods agreed upon by the PMT. There are technical memos and references to these goals in multiple documents created during the project. For this reason, we recommend keeping the reference as-is. Although outfalls were not selected as monitoring locations, the number and type of outfalls associated with assessment areas and the trash observed will be evaluated during the data analysis to evaluate important relationships that may exist.
3.1	Concord	(page 10) - please delete reference to future phases at end of first paragraph on that page.	Acknowledging that trash monitoring will occur beyond the pilot phase is an important concept to describe because it is consistent with the intent of the pilot-phase described in the MRP. Lessons learned through the pilot phase will be used to redesign the program and attempt to make it as cost effective as possible in the future. A new section 7.3 was included to describe the "adaptive management" of this plan into future iterations that may be more cost-effective than the pilot-phase.
3.1	SF Bay Regional Water Board Staff	This is a Pilot Program, but lacks any water column or water surface sampling for trash in flowing water, or in the water column of lakes and the Bay. Since this is a pilot, some activity which is capable of measuring trash in the water column must be pursued.	See Attachment 2 to the Monitoring Program Plan. As described in the plan, there are many types (e.g., creeks, lakes, lagoons, Bay) and components (e.g., water column, banks/shores, substrate) of water bodies that could conceptually be monitored for trash. Water Body types and components were prioritized during the development of the Monitoring Program Plan with input from Stakeholders, which included Regional Water Board staff. High priority water body types and components that were selected are: 1) consistent with the intent of the MRP provision and fact sheet, which calls for the use of the "simplest and most cost-effective methods"; and 2) the outcomes of a meeting between the Project Manager, consultants and Water Board staff that occurred on December 6, 2016. Not all types of water bodies and components of those water bodies can be monitored during the pilot-phase. The Plan acknowledges the efforts currently underway via the State Water Board and Ocean Protection Council's three-year study, the SFEI microplastics study currently underway, and the coordination between these efforts and the BASMAA pilot-phase that is planned to occur over the next 2 to 3 years. Additionally, the Plan also acknowledges and describes the lessons learned through pilot efforts on monitoring trash in flowing water that were conducted by BASMAA between 2013 and 2016 through a Proposition 84 grant that was funded by the State Water Board. For these reasons, the methods included in Monitoring Program Plan are associated with trash deposited on the creek bed or shoreline, floating in the water, and on the banks of creeks, channels, lagoons and shorelines.
3.2	SF Bay Regional Water Board Staff	Scientific Monitoring Question - What percentages of trash observed in receiving waters are attributable to stormwater conveyance systems, direct dumping, wind, and encampments? It is unclear what methods will be employed to make these very difficult, if not impossible, distinctions about trash origin.	We agree that these distinctions between pathways are very challenging and potentially impossible to make. However, the question regarding relative contributions from pathways was posed by the Water Board in the MRP and Permittees are therefore attempting to address it. The methods that will be used to help distinguish the different pathways (to the extent possible) are described in the plan and protocol (Attachment 7). They are intended to be beta versions that will be evaluated and revised accordingly based to the results and lessons learned during the pilot-phase.
Table 3-2	ADH Environmental (For CCCWP)	This management question, and other like it, are somewhat problematic for the assigning of monitoring questions in this way: how do we know if water quality is impacted by only looking at trash levels and not type? Don't we need to characterize trash type to make statements about water quality? I'm guessing that if we encounter lots of toxic trash versus lots of chemically innocuous trash, we will want to bring that information into our reporting. Does it make sense to add a scientific monitoring question to address this point?	Based on 303(d) listing criteria and recent policies adopted by the State and Regional Boards, all trash types that make their way to RWs in adverse levels are impacting beneficial uses and exceeding WQOs. Therefore, whether a trash item is toxic or not appears to be irrelevant to Water Quality Regulators. For this reason, it was not included as a metric.
3.3	ADH Environmental (For CCCWP)	Page 14. How are non-perennial streams classified and dealt with?	Non-perennial creeks and channels are defined in the RMC as no flowing water during the index period (spring). Many creeks and channels that were monitored via the RMC dry up in the summer and fall. These sites, if previously monitored, are included in the probabilistic draw. Sites that were not sampled by the RMC creek status monitoring because of the lack of flow, are not included in the Trash Monitoring Program.

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3.3.1	Cities of Concord and San Pablo	(page 13)- If there is a pool of 339 regional sites for sampling why does this document propose sampling 125? This means that 36% of the viable sites will be sampled, this amount of monitoring seems excessive for statistical analysts especially because this is supposed to be a pilot program. For this we should be following the RMC bio-assessment model, for this monitoring we sample 10-15 sites per year in Contra Costa County not 30.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. Subsequently, this number of sites was presented to the Peer Reviewers in the Draft Plan. Reducing the number of sites now would undermine previous agreements and the Peer Review process. Additionally, the number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. If the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring.
3.3.1	SF Bay Regional Water Board Staff	The Qualitative sampling sites which piggy back on bioassessment sites, and will be sampled at the same location for several years, need to be biased toward sites with more urban watersheds, and possibly more high trash generation areas in those urban watersheds. Sites downstream of primarily single-family residential will be of little value over the years.	At this point, the spatial distribution of trash levels in streams is largely unknown. Therefore, by monitoring a range sites that can help describe the "population" of trash levels in creeks, channels and shorelines, we are explicitly not trying to constrain our sites to heavily urbanized areas. Additionally, the transport of trash from upstream locations to downstream sites is also possible. Regardless, the vast majority of sites that will be sampled via the probabilistic and targeted poll will be within heavily urbanized areas where trash is present. Characteristics of all probabilistic sites are included as an Attachment to the Plan.
3.3.2	City of Sunnyvale	Are there any specific considerations to account for in determining which Hot Spot locations should be identified as "targeted sites?" Should efforts be made to spread sites evenly across permittees – e.g., will it be half of each permittees required Hot Spots or some other determination?	When selecting sites, Permittees should try to select at least one targeted site within or directly downstream of each Permittee's jurisdictional area. This will both allow the level of effort for monitoring to be spread across Permittees, and provide data regarding trash in water bodies directly associated with each Permittees discharges. Although it is acknowledged that at least one site per Permittee may not be possible, guidance was included in the plan to indicate that this should be a goal when selecting targeted sites.
3.4	Santa Clara Valley Water District	Page 16: second paragraph, 6th line, it should be "addressing" rather than "address"	Suggested edit was made.
4.1	Santa Clara Valley Water District	Page 18: footnote, I would prefer to see a common sort list as this is a great opportunity to maybe work on the Coastal Clean Up list that volunteers used. Also, this footnote could refer to the common items observed that was added to the protocol.	As agreed by the PMT, sorting and characterizing trash is not included in the protocol. We encourage Permittees to continue to collaborate with other trash monitoring programs to standardize lists of items.
4.2	City of Pittsburg	Section 4.2 Selecting Sites from Probabilistic Site Pool – the referenced Attachment 6 only lists one site for my jurisdiction. This site is unsafe - yet there are no other locations listed for Pittsburg on this table, but Figure 3.2 shows 5 other locations.	Probabilistic sites are not intended to be representative of specific jurisdictions, rather they are collectively intended to represent the current condition or level of trash in all creeks and channels that are present within broader spatial scales (e.g., countywide or regional). Therefore, not all Permittees are intended to have a probabilistic site located within their jurisdiction.
4.3	City of San Jose	Page 25. Are we measuring width at three locations as well? The photo on the next page has 2 'x' marks. Is this where we are suppose to measure width?	Width measurements should occur at three locations (downstream, midpoint and upstream). Pictures that included in this section will be updated to illustrate this process.
4.3.1	City of Sunnyvale	Please clarify at point where the photo documentation should be taken (e.g., top of bank, middle of assessment area, etc.) Photos from top of bank may not adequately document level of trash in vegetation.	The text was revised to indicate that pictures should be taken as near to the active channel as possible.
4.3.2	Santa Clara Valley Water District	Page 21: revise top picture to indicate width is measured on the ground	The picture will be edited to illustrate this concept.
4.3.2	City of San Jose	Page 26. How do we measure width on a shoreline?	The width of a shoreline site will be measured from the water's edge at the time of monitoring to the high water line, which will be identified based on the change in substrate or onset of development.
4.4/4.5	Santa Clara Valley Water District	Page 22: second paragraph: I know it's not technically a pathway but homeless encampments should be mentioned (and are a category of pathway in the protocol).	Although illegal encampments are a type of the "direct dumping" pathway, they will be called out as a separate pathway given that trash associated with illegal encampments can generally be identified and management actions are different for illegal encampments versus illegal dumping.
4.4	City of Sunnyvale	It may be informative to include any known information on outfalls within or immediately upstream of the assessment areas including municipal, private, and/or Caltrans outfalls. There are some reaches of creeks/channels that include outfalls from multiple sources within a stretch. May also be good to include on Data Collection form.	We agree that identifying outfalls in the assessment area would be useful information. The data collection form will be updated to include space for a site map that can be used to mark the location of outfalls. The field data collection form will also be updated to indicate the number and size category of outfalls within the assessment area.

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4.4	City of Concord	(Page 22)- There needs to be discussion in the document regarding the difficulty in determining the transport pathways (i.e. stormwater, wind, dumping etc.). Especially the difficulty in distinguishing between wind and MS4.	Additional discussion was added to the plan regarding the very challenging (possibly impossible) process of identifying specific pathways and the relative percentage of trash observed from each. Additionally, the categories will be changed to the following: illegal encampments, illegal dumping, litter/wind, and other/unknown (e.g., upstream sources and stormwater).
4.5	City of San Jose	Page 25. How will trash generated by creek occupants be differentiated?	Trash associated with illegal encampments will differentiated using the guidance in the protocol. Should the encampment be active, the amount of trash associated with that encampment should be estimated while in the field, left in place, and reported for removal by the appropriate entities using the appropriate methods.
4.5	Santa Clara Valley Water District	Based on today's discussion about homeless encampment, some guidance should be provided if an encampment is found at a hot spot.	Additional guidance was provided in the Plan and protocol to indicate that if an active encampment is encountered, the amount of trash associated with that encampment sould be estimated while in the field and reported for removal by the appropriate entities using the appropriate methods.
4.4	Santa Clara Valley Water District	Page 22 and 23: I thought we were including listing top trash items observed – it's in the protocol but not the text here	Text was added to the plan to indicate this.
5.1	City of San Jose	Page 30. Is this person an MRP Permittee staff member?	See comment below regarding the role of the Monitoring Program Manager and Field Crew Supervisor.
5.1	City of San Jose	Page 30. How is this to be conducted? Same day as original sort?	There is no "sort" being conducted, with the expectation of the pathways analysis. Text was added to explain how the precision QA/QC component will be conducted.
5.1	City of San Jose	Page 30. Also, it seems that pathway identification is the most difficult task that should be refined.	We agree. The pathway categories were refined (see comment above). Additionally, to reduce the subjectivity of the estimates, Field Crew Supervisors will be required to attend training on the protocol and Monitoring Program Managers will conduct QA/QC procedures to identify and resolve any major issues with data collection efforts conducted by Field Crew Supervisors.
5.1	City of Sunnyvale	This section discusses roles for "Monitoring Project Manager" and "Field Crew Supervisor." These roles are not identified or described in the accompanying SOP. Also, narrative assumes one of each of these per County – this should be further discussed and determination if this is realistic resource level at the County level (e.g., should there be at least one of each per County). This may create logistical or scheduling issues for permittee quantitative trash monitoring. If Volunteer Monitoring is conducted, will the volunteers also need to have the designated Field Crew Supervisor/Monitoring Project Manager present at their monitoring/cleanup events?	Definitions and roles of the Monitoring Project Manager and Field Crew Supervisor will be added to the plan. There should be one Monitoring Program Manager for each county. The role of the Monitoring Program Manager is to oversee and coordinate all aspects of the monitoring program from a specific county, including training, data management, and QA/QC. There should be one or more Field Crew Supervisors for each county. Field crew supervisors should be trained in the protocol and present at all monitoring and assessment events. The role of a field crew supervisor is to oversee the data collection and QA/QC in the field, and complete and manage field forms.
5.1 (Item 4)	City of Sunnyvale	Precision. For 10% of the events, crew members will complete .... Is this 10 % over all 100? How will these be decided? Will this be Field Crew Supervisor and permittee staff? More clarity needed on who does what.	10% of sites for each county will be "reanalyzed". The sites will be randomly picked. The roles of crew members (including the field crew supervisor) in this process are now better explained in the plan.
6	City of Pittsburg	Section 6 – Data Management – When in the data collection phase will data be entered into CEDEN? Will it be entered by the consultant or permittees? How will QA/ QC be done before data is loaded onto CEDEN?	Standard procedures on how to conduct QA analyses and data entry for other types of water quality data have been developed by BASMAA and will be referenced in the Plan. Additionally, since the data are "pilot", the requirement to flag all data as "provisional" will also be added to the data management section.
6.1.3	Santa Clara Valley Water District	Page 28: first paragraph, fourth line: typo, should be "publicly"	The recommended edit was made.
6.2	ADH Environmental (For CCCWP)	Page 34. Define COV (coefficient of variation). Add "generally" to the parenthetical statement since steepness of the plot indicating smaller or larger COVs is always true only for results with the same mean.	COV is now defined and the term "generally" has been added.
6.2	ADH Environmental (For CCCWP)	Page 33. Food for thought: There is a great degree of similarity between the proposed analysis of trash and soft- or hard-bottom benthic infaunal community analysis. These biostatistical analytical methods use some standard indices to characterize the complete ensemble of organisms in each sample, and compare these ensembles. Some of the more commonly used indices are Shannon-Weiner Diversity, Dominance, Number of Species, Total Number of Individuals, Number of Species accounting for XX% of the total number of individuals, etc. Analogues of many of these indices could be developed and applied to trash sample data and be used to characterize entire samples. Other multivariate methods such as cluster analysis, factor analysis, etc. could also be used as they are on benthic communities to further examine any relationships between trash data samples.	Good suggestion. We agree that where possible and appropriate, those analyzing the trash data for each county should consider using these approaches.

Section	Stakeholder	Comment	BASMAA's Response to Comments
6.2	ADH Environmental (For CCCWP)	Page 34. This kind of analysis is known as post-hoc or a-posteriori. A t-test or a non-parametric equivalent can only test two means at a time. After an ANOVA, the tests would have to be applied to all pairs of means. This has what is known as the multiple comparisons problem. The significance probabilities would have to be Bonferroni- or Sidak-corrected, which would lower the power of the analysis. The preferred approach is to use a procedure that avoids this problem by comparing all mean differences or ranges of differences to a single statistic. Examples are Tukey's HSD Multiple Range Test (MRT) or Fisher's Least Significant Difference (LSD) test. One or both of these should be used as an example analysis rather than the Student's t-test. It should also be noted that in two- or three-way designs these MRT/LSD tests can be run on main effects variables if and only if the related interaction terms are not statistically significant, typically at the 5% level.	Thank you for the suggestion. Text was revised to incorporate MRT and LSD as possible statistical methods that interpreters should use when analyzing the data.
6.2	ADH Environmental (For CCCWP)	Page 36. There are some omissions in this paragraph. It is suggested that it be rewritten like this: *ANOVA tests are a set of parametric and non-parametric tests that are used to determine if a set of samples have different means that are based on one or more groupings such as location and time of collection. The number of these groupings, or factor variables, determines if the test is a one-factor, two-factor, etc. design. Parametric ANOVA's require that the data in each grouping as well as their residuals derived from the analysis be normally distributed and that the variances be the same in each group. An additional requirement is that two-factor designs with a single observation per cell must be additive. Non-parametric versions don't have these requirements, and are applicable to any data with a consequent sacrifice in power. Generally, ANOVA compares the mean values of each group with the overall mean for the entire data set. If the group means are dissimilar, some of them will differ from the overall mean. For a two-factor ANOVA, the influences of two explanatory variables are simultaneously tested. For example, a two-way ANOVA can be used to examine the effects of different seasons and different locations, along with the interaction of these parameters. A two-way ANOVA will be performed on the data to evaluate if the trash data collected varies by site and/or by season if there are no significant interaction effects.*	The text was revised to incorporate the concepts that are included in the comment.
6.2	ADH Environmental (For CCCWP)	Page 36. This section states regression analyses are to be performed to evaluate relationships between qualitative assessment and quantitative monitoring. As both types of scores have built-in uncertainty, the appropriate type of regression is Model II. The actual analysis described in this section is analyzing correlation coefficients rather than regression results. As long as that is done, there is no problem. However, any regressions that are performed on data of this type need to be Model II, and not Model I. The latter is the usual choice, and it is often applied incorrectly.	We agree. Text will be added to indicate that either correlation coefficients of regression models may be used and that the interpreters should evaluate and select the appropriate statistical methods.
6.2	Santa Clara Valley Water District	Page 29: Scatter plot bullet, TCT was not previously explained and is probably a cut/paste issue and should instead say receiving water monitoring data.	TCT was inadvertently referenced and will be removed.
7	City of Sunnyvale	Resource Needs seem low and do not reflect that you may need multiple staff/persons to perform a task (measurements of length and width of monitoring area; two individuals to conduct qualitative assessments, etc,). Total hours per event could easily be double what is shown.	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
7.1	ADH Environmental (For CCCWP)	Page 38. Since this section addresses estimates only for conducing field assessments (not inclusive of parcel ownership review, procurement of encroachment permission, reconnaissance, etc.), consider changing the section heading to "ESTIMATED LABOR RESOURCES NEEDED DURING FIELD MONITORING" or something similar.	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
7.1	City of Pittsburg	Section 7 Table 7-1 doesn't include time for documentation and processing data	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
7.1	City of San Jose	Page 38. These numbers seem quite low. This does not seem like it is based on actual staff or contractor time to implement these activities.	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
7.1	Contra Costa County	I'm concerned about these estimates. I assume that the planning includes time to receive permission to go on site and to do field reconnaissance. I haven't worked on this task previously but if it is tricky obtaining permission and there is additional paperwork, including encroachment permits, organization, and field reconnaissance, it seems that it may take significantly more time to complete, maybe three times as much.	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.

Response to Stakeholder Comments on Draft Receiving Water Trash Monitoring Program Plan (May 30, 2017)

Section	Stakeholder	Comment	BASMAA's Response to Comments
7.1	Contra Costa County	In terms of the qualitative assessments, the time to complete these assessments may be underestimated if the site has a lot of vegetation and there are photos and field notes to transcribe or enter into another system and organize.	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
7.1	Santa Clara Valley Water District	Page 33: half hour seems short for travel	Estimated staffing needed to prepare for, conduct and report on trash monitoring/assessment was updated based on additional information provided by stakeholders and the PMT.
Table 7-2	City of Sunnyvale	Table 7.2 shows that Quantitative Monitoring at 12 Targeted sites will done in Wet Season (2017-2018 and 2018-2019) yet on Page 16 under 3.4 (Timing and Frequency) it shows Targeted sites only monitored during Dry Season. Please correct. If Wet Season quantitative monitoring is to be conducted, which sites will be selected?	The table was corrected as described. Only two quantitative events will be conducted at each targeted site during the pilot-phase.
References	ADH Environmental (For CCCWP)	"BASMAA, 2015" is missing from the references.	The reference was added.
Figures	Contra Costa Clean Water Program (CCCWP)	For Figures 3-1 through 3-5, add city boundaries to better depict the location of the sites relative to city boundaries – if possible – if it is too busy and difficult to read, ignore the comment.	City boundaries on top of the creeks and background are hard to see and distinguish. For these reasons, they were not added to the figures.
Figures	Contra Costa Clean Water Program (CCCWP)	Ensure that the number of sites per County listed in Attachment 6 match the number of red dots on the respective figure.	All 64 sites listed in Attachment 6 are included in Figure 3-2. Some circles depicting sites overlap and are difficult to see.
Figures	Santa Clara Valley Water District	Figure 3-2: the colors for the various items are different from the other figures and the trash boom and probabilistic are very similar	The color of the trash booms in the legend was changed to orange, consistent with the other figures.
Attachment 2	Santa Clara Valley Water District	Attachment 2 should have page numbers. The last paragraph of the camera section is missing an "of" between "use" and "fixed" in the second line	The recommended edit was made.
Attachment 2	Santa Clara Valley Water District	Attachment 2: Last paragraph of flux monitoring, third line, I think a “not” is missing between “were” and “recommended”	The recommended edit was made.
Attachment 5	Santa Clara Valley Water District	Attachment 5: needs page numbers. Paragraph ahead of figure A5-4 has some typos: Second line: Figure s should be Figures and sixth line, is missing “of” or some other word before “relationship”. This word is missing in other sections too (e.g. ahead of figure 57-10 (which I’m not sure why it’s not A5-10)	The recommended edit was made.
Attachment 7	ADH Environmental (For CCCWP)	Page 56. In addition to the 5 most abundant trash types, we should document the presence of trash that has a high potential to impact water quality (i.e., toxic substances). The field datasheet could have a check-box listing of common toxic substances that the crew could check if found.	Based on 303(d) listing criteria and recent policies adopted by the State and Regional Boards, all trash types that make their way to RWs in adverse levels are impacting beneficial uses and exceeding WQOs. Therefore, whether a trash item is toxic or not appears to be irrelevant to Water Quality Regulators. For this reason, it was not included as a metric.
Attachment 7	ADH Environmental (For CCCWP)	Page 52. Please see the related comment below in Section 5.1. Ten scoring options is probably too many.	The metrics used to evaluate the extent of vegetative cover were revised. The protocol now requires field crew supervisors to estimate the percent of the assessment area that is covered by vegetation or vegetative debris that could capture trash, and the type of vegetation observed (by percentage).
Attachment 7	ADH Environmental (For CCCWP)	Page 52. The number of numeric values for the site score is too large. How would someone decide between a 5 (lowest degree of Very High) and a 6 (highest degree of High) for the trash level score assigned to a given assessment area? There is too much reliance on subjective judgment in this method to justify so many score values. As these results are going to be analyzed numerically, the need for meaningful data is high. This scale should be simplified into perhaps five values (very high, high, moderate, low, trace to none)	For the purpose of the pilot-testing phase, the 20 scoring range provides the level of precision that we believe may be possible. Based on the lessons learned in the pilot-phase, the range may be reduced in future iterations the protocol.
Attachment 7	ADH Environmental (For CCCWP)	Page 54. As with the proposed 1-20 scale for site condition above, this scale with eleven values is too fine if it is to be determined by general observation alone and the results are expected to be meaningful. An example: Estimates of percent cloud cover are quantized to 10%. The user must determine how much of the total sky is obscured by clouds. There are just two choices: Cloud/No Cloud. It is relatively simple, and the resulting numerical estimate probably has reasonable accuracy. If this is changed to estimate the percent coverage by cumulus, cirrus, stratus, and other types of clouds, the results would become much less reliable. An alternate method to estimate the site pathway percentages would be to count all of the trash in an assessment area and assign each piece to one of the trash pathway categories. However, given the size of the assessment areas, this would probably be prohibitively time consuming.	We agree that quantifying trash items might provide additional levels of precision. However, given the resource constraints and the need to use the simplest methods that give adequate levels of precision, the PMT agreed to use a "gross volume" approach, which is based on numerous studies conducted by BASMAA and its member agencies in the Bay Area. The precision of "gross volume" estimates is adequate at this pilot-testing phase.
Attachment 7	ADH Environmental (For CCCWP)	Page 53. For Bay and Delta shoreline assessment areas, such as in Figure 3-4 below, we probably need a category for "currents"	We are not sure what the commenter was suggesting should be included in the protocol for "currents". If the commenter is referring to "direction of the current", it would be very difficult for field crews to document this data point and therefore the protocol was not changed.

Response to Stakeholder Comments on Draft Receiving Water Trash Monitoring Program Plan (May 30, 2017)

Section	Stakeholder	Comment	BASMAA's Response to Comments
Attachment 7	Cities of Concord and San Pablo	Section 3.3.1 (page 13)- If there is a pool of 339 regional sites for sampling why does this document propose sampling 125? This means that 36% of the viable sites will be sampled, this amount of monitoring seems excessive for statistical analysts especially because this is supposed to be a pilot program. For this we should be following the RMC bio-assessment model, for this monitoring we sample 10-15 sites per year in Contra Costa County not 30.	At their May 1, 2017 meeting, the PMT agreed to collectively monitor 100 targeted sites and 125 sites. This agreement was memorialized in meeting minutes that were reviewed and approved by the PMT. Subsequently, this number of sites was presented to the Peer Reviewers in the Draft Plan. Reducing the number of sites now would undermine previous agreements and the Peer Review process. Additionally, the number of targeted and probabilistic sites included in the plan begins to help fill the lack of information that currently exists regarding the trash levels in creeks/channels, and evaluate the appropriate type of trash protocols to use when measuring trash in water bodies with different characteristics. If the number of sites were to be lowered, the power/confidence in results from monitoring conducted during the pilot phase would be severely reduced, potentially jeopardizing the extent to which MRP management questions could be answered and lessons learned could help inform future iterations of RW trash monitoring.
Attachment 7	City of San Jose	Page 52. Add: *Heat illness prevention tips *Use proper lifting techniques *Always work in groups of 2 or more	The recommended edits were made.
Attachment 7	City of San Pablo	Please provide strong caveats directly in the text (not just a footnote) regarding the uncertainty and difficulties in determining the sources of a piece of trash, specifically the difference between windblown and stormdrain.	Text will be added to indicate that these are very rough estimates of the relative contributions of each pathway. Additionally, the pathway categories are being refined and stormwater will be included in the "other" category, along with wind and upstream sources.
Attachment 7	City of San Pablo	Remove all “homeless encampment” references. Please refer to them as illegal encampments or just encampments.	The recommended edit was made.
Attachment 7	City of San Pablo	Vegetative condition assessment- Please provide pictures for the different vegetation ratings.	We currently do not have pictures representing each vegetation rating. Subsequent iterations of the protocol should include such pictures.
Attachment 7	City of San Pablo	The pictures provided for the trash level condition assessment are very difficult to see. In most I can’t tell the difference between leaves and trash.	We have reviewed many images to find the best pictures depicting the different condition categories. Those included in the protocol are the best we currently have. As additional images are recorded during the pilot-phase, pictures included in the protocol should be revised accordingly in the next iteration.
Attachment 7	City of Sunnyvale	Pg 4, Section 4.2 – please provide additional guidance on vegetative condition assessment scoring	Additional guidance on scoring was provided.
Attachment 7	City of Sunnyvale	Pg 3, Section 3.2– will training be done on sensitive wildlife species for those that don’t know if there may be such in their area(s)?	Identification of sensitive wildlife species should be included in the training. The text was revised to indicate this.
Attachment 7	City of Sunnyvale	Pg 2, Section 2.1 – how often to length and width measures be conducted? Does this need to occur with each monitoring event? Or, can it be done once for term of Pilot?	Length and width measurements are only required at the first monitoring event as long as the same area is assessed during subsequent events. Field crews should adequately mark the assessment area to insure that the same area is assessed during all monitoring events. Text was added to make this clear.
Attachment 7	City of Sunnyvale	Pg 7, Section 6.1 (pg 7) Estimate Trash Volume – First sentence states that all trash should be collected, then on bottom of page (bold and underlined), it states that items associated with stormwater pathway should be collected first. This should be clarified as one or the other. If it is that we need to pick up one first, then the other, this will triple the amount of time as we’d have to go through the same area three times. What about collecting all trash and sorting up above on the shoreline, starting with stormwater path first.	The order to which the pathways are identified is not important and the text will be revised to remove this step. Sorting to identify the pathways can be done within or outside of the channel.
Attachment 7	City of Sunnyvale	Pg 4, Section 5 – Qualitative Assessment – the SOP should be clear about number of crew members needed; and if they are collectively scoring or averaging separate scores. Procedure should specify any differences when doing QA/QC assessments.	The protocol was updated consistent with the comment.
Attachment 7	City of Sunnyvale	Pg 2, Section 2.2 second to the last sentence (for sites where the top …. Remove the word on after the word distance.	The recommended edit was made.
Attachment 7	City of Sunnyvale	Pg 5, Table 1 of condition categories – there should be a definition for “short timeframe”	The recommended edit was made.
Attachment 7	City of Sunnyvale	Pg 2, Section 2.1 – second paragraph shows that there will be 4 width measurements taken for creek/channel. Please confirm number of width measurements needed for shoreline locations – still 4 or more? Mentions to see information on pics below, but nothing is listed	Width measurements are required at each 100 ft segment, totaling 3 width measurements for creeks/channels and shorelines. Pictures and text in the Plan were revised to indicate this.

Response to Stakeholder Comments on Draft Receiving Water Trash Monitoring Program Plan (May 30, 2017)

Section	Stakeholder	Comment	BASMAA's Response to Comments
Attachment 7	City of Walnut Creek	Section 4.2 SOP (Attachment 7). Include some examples and more explanation of what considered VH, H, M and Low vegetative condition. Are we looking at the shrubbery and grasses only? Are we looking at overgrown trees as well.	Additional guidance was provided as suggested.
Attachment 7	City of Walnut Creek	Table 1 of SOP (Attachment 7). I would suggest including a time reference for each trash condition categories. As an example: For Low trash condition category - one individual can easily clean up all trash observed within 30 minutes; for Moderate - one or two individuals within 1 hour; and so forth	The time needed to cleanup trash will be somewhat dependent on the width of the assessment area and the channel type. We have updated the definitions to include a range of average time and level of effort (# of people) that would be expected to be needed to clean the site.
Attachment 7	City of Walnut Creek	Table 2 of SOP does not mention about a possible trash pathway from upstream flow. This happened during heavy rain events that carried trash from an upstream communities down the watershed	Upstream sources is now included in the "Other" category, which also includes stormwater.
Attachment 7	Santa Clara Valley Water District	Based on the discussion about the possibility of homeless encampments at hot spots and probabilistic sites, additional guidance or maybe a separate protocol (refer to City's existing policies but include in health/safety too) is needed to address homeless encampments and estimate volume of trash.	Additional guidance was provided in the Plan and protocol to indicate that if an active encampment is encountered, the amount of trash associated with that encampment sould be estimated while in the field and reported for removal by the appropriate entities using the appropriate methods.
Attachment 7	Santa Clara Valley Water District	Data Collection form, sort list, may be helpful to split in small and large items as follows: Small items should include the following: Food wrappers, Glass bottles, Plastic bottles, Food related plastic: cups, lids, straws, utensils, take out containers, Other plastic, Clothing/shoes, Sports balls, Spray paint cans, Food related Styrofoam, Non-food Styrofoam, Aluminum, steel, tin cans, Cigarette butts, Single use plastic bags, Automotive related and other chemical/haz waste (propane canisters, batteries), Biohazards (syringes, diapers, human waste, pet waste), Paper products/cardboard. Large items should include: Shopping carts, Mattresses, Coolers, Furniture, Appliances, Tires, Bags of trash, Bicycles, Construction debris, Car parts	Examples of small items (e.g., can fit into a garbage bag or 5-gal bucket) and large items (e.g., are too large to fit into a bag) will be added, consistent with the commenters suggestion.
Attachment 7	Santa Clara Valley Water District	Health and Safety: should this include some reference to homeless encampment protocols? It just says not to take trash, but looks like some permittees clean up encampments at hot spots.	The recommended edit was made.
Attachment 7	Santa Clara Valley Water District	Page 6: add tires and mattresses to illegal dumping list. Mattresses may also be part of homeless encampments – I think this might be an old list that had been revised?	The recommended edit was made.
Attachment 7	Santa Clara Valley Water District	Figure 3.2 and 3.3: revise width indication to go along the ground	The recommended edit was made.
Attachment 7	Santa Clara Valley Water District	Figure 3.4: it might help to show the changing width in the upstream area	The recommended edit was made.
Attachment 7	Santa Clara Valley Water District	Page 7, last line, should we add "likely" before "associated" to indicate that we won't be sure what's stormwater vs. another pathway?	The stormwater and wind pathways were combined into the other categories. Wind is now grouped with litter and stormwater is included in the "Other/Unknown" category which also includes upstream unknown sources.
Attachment 7	Santa Clara Valley Water District	Attachment 7: page 3: project planning should include obtaining access?	We agree. Text was added to indicate that obtaining access is part of the planning process.
Attachment 7	Santa Clara Valley Water District	Should photos be taken of the bagged/containerized trash? I have found that helpful	Yes. The text was edited to indicate that photos of trash removed should be photographed as well.
Attachment 7	City of Pittsburg	From time to time, City staff needs to remove camps from these areas. They document loads by cubic yards, roughly characterize the type of debris, and sometime photograph. How will this type of data be integrated with the quantitative analysis, when these occur outside of the assessment schedule?	Documentation of whether a site was cleaned between monitoring events is an important data point that should be documented. We have included a spot on the field data collection form (Attachment 7) to identify the date of prior cleanups (if known).
Attachment 7	City of Pittsburg	Page 6 change "relatively" to "relative"	The recommended edit was made.

Attachment 9

San Francisco Bay Regional Water Quality Control Board Staff Comments and Responses

July 31, 2017
CIWQS Place No. 756972 (DCB)

To: Municipal Regional Stormwater NPDES Permit Permittees

Sent via email to:

James Scanlin, Alameda Countywide Clean Water Program: jims@acpwa.org
Rachel Kraai, Contra Costa Clean Water Program: Rachel.Kraai@pw.cccounty.us
Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program: kcullen@fssd.com
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Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program: awo@eoainc.com
Jennifer Harrington, Vallejo Sanitation and Flood Control District: jharrington@vsfcd.com
Jill Mercurio, City of Vallejo: jill.mercurio@cityofvallejo.net
Geoff Brosseau, Bay Area Stormwater Management Agencies Association: Geoff@brosseau.us
Beth Baldwin, Contra Costa Clean Water Program: Beth.Baldwin@pw.cccounty.us

Subject: Comments on Receiving Water Trash Monitoring Plan for Water Board Order No. R2-2015-0049, Municipal Regional Stormwater NPDES Permit, Provision C.10.b.v

Dear Permittees:

On June 30, 2017, the Bay Area Stormwater Management Agencies Association (BASMAA) submitted a Receiving Water Trash Monitoring Plan for the San Francisco Bay Region (Plan), in accordance with provision C.10.b.v of the Municipal Regional Stormwater NPDES Permit (MRP), Order No. R2-2015-0049, NPDES Permit No. CAS612008. The Plan was submitted on behalf of the seventy-six Permittees regulated by the MRP.

We have the following primary comments on the submitted Plan. Please address them and submit a revised Receiving Water Trash Monitoring Plan. We would be happy to discuss the comments further.

1. The Plan does not yet propose water surface and water column sampling quantitatively in flowing water (creeks, rivers) or in San Francisco Bay as part of the monitoring pilot program. Addressing only water surface and shoreline trash to monitor the status of trash in receiving waters is insufficient. A thorough program, including quantitative components, to determine the presence and amount of floating and suspended trash particles in flowing and semi-static water is necessary to determine the trash impact to receiving waters.

2. The assessment of trash on banks and shorelines is proposed as pilot work. However, Permittees have over 5 years of experience with visual trash assessments and the collection and analysis of trash volume and type on creek banks and shorelines. As such, creek bank/hot spot qualitative and quantitative methods should not be considered pilot /experimental procedures. The only new aspect of this effort is employing quantitative visual assessment in the context of creek banks and shoreline assessment.

Additional Comments

The MRP sets forth a series of bulleted questions that must be addressed by receiving water monitoring and the development of receiving water monitoring tools and protocols. The proposed study methodologies will address those questions, except: if trash is being transported from one receiving water to another, and the presence of trash in the water column. A footnote to Table 3-3 states that acceptable methodologies are not currently available to determine if trash is transferred between water bodies. That is one reason for the current pilot work, which requires Permittees to develop, or attempt to develop, a method of estimating the portion of trash in the Bay that may be transported from upstream lotic waterways.

Refined Receiving Water Monitoring Questions numbers 1, 2 and 3, as presented in Table 2-3, cannot be adequately answered without water column data. This underlines the importance of working to collect that data.

The Plan proposes to monitor trash on shorelines and water surfaces. Monitoring will occur at 125 probabilistic (ambient, random) sites and 100 targeted sites, including some existing trash Hot Spots.

Targeted sites are not proposed to be monitored during a wet season. The proposal does not include collection of quantitative data for the wet season at any targeted sites. Wet season data should be included as much can change at sites months after the wet season.

Some targeted sites are co-located with existing trash Hot Spots. The data collected to meet the trash Hot Spot monitoring and cleanup requirements may be included as receiving water monitoring data. Additionally, the Plan has guidance for defining trash assessment areas (Attachment 1). Please consider adding qualitative observations of the general area outside the defined assessment areas to this guidance or the associated protocols. That is, the Plan anticipates that trash in the assessment areas may be coming from the adjacent receiving water. At the same time, a number of receiving areas are likely to be impacted by direct discharges associated with homelessness and illegal dumping. It may be helpful to understand, via a qualitative observation of the area surrounding the assessment area, whether direct discharges are an immediate source

to the assessment area (e.g., whether there are accumulations of trash discharging down a streambank).

The report recommends against monitoring at trash booms because of the variability and timing of deployment and effectiveness of the booms. Since trash booms collect material from upstream, booms should be included as a pilot approach to develop a reproducible method for their use in monitoring. If a location with a trash boom is monitored, quantitative monitoring is recommended.

Attachment 7, Standard Operating Procedure for qualitative and quantitative trash assessments, proposes a 0 to 20 scoring range for visual assessments, divided into four bins (very high, high, moderate, and low). This number of ratings, including 5 sublevels in each category, seems likely to present challenges. Can the sublevels be consistently assessed across varied staff, events, and locations, such that they would be a consistent indicator of difference? It may simplify data collection and analysis to reduce the number of sublevels or omit them and use the four categories.

Section 6, Data Management, Analysis, and Interpretation, proposes using CEDEN for data aggregation and management. This proposal is acceptable if CEDEN can be effectively modified in time to meet program needs. However, it is unclear whether this can be accomplished. For example, CEDEN is not currently set up to accept photographic monitoring, and it is unlikely that will change during the current permit term.

Section 6.1.2, Data Management QA/QC Considerations, describes multiple approaches to data presentation. Data presentation can be further discussed and determined based on the data collected. The current means of data presentation, in the annual report and in Tracking California Trash, may be preferable to facilitate long term data and trend analysis.

If you have questions or would like to discuss the matter further, please contact Dale Bowyer at (510) 622-2323 or via email to dbowyer@waterboards.ca.gov.

Sincerely,

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for Bruce H. Wolfe
Executive Officer

Cc: George Hicks, City of Fairfield: ghicks@ci.fairfield.ca.us
Timothy McSorley, City of Suisun: tmcsorley@suisun.com
Jill Bicknell, SCVURPPP: jcbicknell@eoainc.com

BASMAA Responses to Water Board Staff comments (dated July 31, 2017) on Receiving Water Trash Monitoring Program Plan.

WB Comment	BASMAA PMT Response	Revisions to Trash Plan
The Plan does not yet propose water surface and water column sampling quantitatively in flowing water (creeks, rivers) or in San Francisco Bay as part of the monitoring pilot program.	Water Board staff comments incorrectly indicate that water surface sampling is not proposed by BASMAA in the Receiving Water Trash Monitoring Program Plan (Monitoring Program Plan). The methods developed and proposed by BASMAA include the assessment of the levels and dominant pathways of trash within 300-foot assessment areas. These areas include both the *water surface* and adjacent banks (up to high water mark) of flowing creeks/rivers where trash levels deposited within the assessment area will be assessed and quantified.	No revisions.
Addressing only water surface and shoreline trash to monitor the status of trash in receiving waters is insufficient. A thorough program, including the quantitative components, to determine the presence and amount of floating and suspended trash particles in flowing and semi-static water is necessary to determine the trash impact to receiving waters.	As described in the Monitoring Program Plan, trash can be assessed/monitored in many different types of water bodies and components within those water bodies. Current methods used to monitoring these water bodies are described in Attachment 2[1] to the Plan and in the final report for BASMAA's *Tracking California's Trash* project (State Water Board funded), which tested methods to measure the presence and amount of floating and suspended trash particles in flowing water bodies. Based on these extensive reviews and testing of trash monitoring methods, the Monitoring Program Plan acknowledges that implementing a monitoring program to monitor all water body types and components (including suspended trash in flowing waters) during the MRP 2.0 (provision and fact sheet) timeframe is not practical and is generally inconsistent with expectations set in the MRP (see MRP Factsheet) and by the Water Board Chairperson.[2] BASMAA has genuinely attempted to respond to the spirit of the MRP requirements to develop and implement a Trash Monitoring Program in Receiving Waters by selecting/developing methods that are based on well-tested and practical approaches, and are cost-effective and do not drastically divert resources away from trash control measures. In this spirit, the proposed Monitoring Program Plan focuses on monitoring trash that is deposited in flowing water bodies and shorelines during this permit term because methods to measure this component of these types of water bodies are the most well established protocols available. The Plan goes on to state that this is the most responsible approach to take over the next 2+ years because parallel efforts (i.e., State Water Board's evaluation and testing of trash monitoring methods) that BASMAA member agencies will actively participate in, are currently underway to further evaluate and test trash monitoring methods that will provide statewide guidance on this subject. Additionally, pilot microplastic monitoring in the Bay is also underway via the Regional Monitoring Program for Water Quality in the	Revise text to describe clearer levels of commitment that BASMAA member agencies will make to actively participating in 1) the State Water Board's project to evaluate and test receiving water trash monitoring methods; and 2) the RMPs microplastics strategy for the monitoring the Bay.

[1] Summary Review of Historical and Current Receiving Water Monitoring Efforts, Methodologies and Protocols for Trash

[2] Consistent with the Water Board Chairperson's statements during the MRP hearing about her expectations for the Trash Monitoring Program during MRP 2.0, the proposed BASMAA monitoring program focuses on measuring trash that is deposited on creek banks and shorelines, not floating or suspended in flowing and semi-static water. The audio of Chairperson Young's comments can be found at http://www.waterboards.ca.gov/sanfranciscobay/board_info/minutes/2015/11-18-15.mp3 timestamp of 3:04-3:09.

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	Bay (i.e., RMP) and BASMAA member agencies are actively participating in this study as well through their participation in the RMP. Both of these parallel efforts will assist BASMAA in determining the efficacy of implementing trash monitoring methods that focus on monitoring water body types and components other than those proposed in the Monitoring Program Plan. Based on the lessons learned over the next 2+ years through BASMAA's and parallel efforts focused on testing monitoring methods, BASMAA plans to recommend trash monitoring methods and approaches that should be considered for implementation during MRP 3.0. These recommendations will include lessons learned through BASMAA's, the RMP and State Water Board's efforts to identify the most practical and repeatable methods for monitoring trash in receiving water bodies and components of those water bodies. These recommendations will be included in the Final Monitoring Report developed through the BASMAA Trash Monitoring Program and submitted to the Water Board as part of the Report of Waste Discharge by July 1, 2020. Although we fear that the data may be of limited use because of site-specific considerations regarding the capture efficiencies of different booms and the maintenance methods used to remove trash from booms, BASMAA member agencies willing include quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons to better understand the utility of data collected from these monitoring locations to answer management questions outlined in the MRP. The number and location of trash booms that will be included in the Monitoring Program is currently under development and will be included in the Revised Monitoring Program Plan submitted to the Water Board EO for approval.	Revise Plan to state that quantitative trash monitoring at existing trash booms will be included in the Monitoring Program. Quantitative monitoring SOP will be used to collect data at trash at booms.
…..creek bank/hot spot qualitative and quantitative methods should not be considered pilot /experimental procedures. The only new aspect of this effort is employing quantitative visual assessment in the context of creek banks and shoreline assessment.	Although methods selected are based on existing protocols (e.g., Water Board's RTA), there are several aspects of the assessment approach that are new and novel with respect to trash monitoring. First, the probabilistic monitoring design will allow for the first comprehensive assessment of trash levels and pathways for different types of water bodies across the Bay Area's urban gradient. Second, a first of its kind comparison of qualitative and quantitative methods will assist in evaluating the relationship between these two methods, which may provide the information needed to allow for more cost-effective qualitative approaches to be used (with confidence) in the future. Lastly, the Plan also includes a first time assessment of trash pathways, which is intended to provide a first-order estimate of the relative contribution of trash from stormwater and other pathways. That said, the word pilot will be removed from the plan to avoid confusion over the use of the term in the Monitoring Program Plan.	The word "Pilot" will be removed from the Plan.

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A footnote to Table 3-3 states that acceptable methodologies are not currently available to determine if trash is transferred between water bodies. That is one reason for the current pilot work, which requires Permittees to develop, or attempt to develop, a method of estimating the portion of trash in the Bay that may be transported from upstream lotic waterways.	BASMAA's *Tracking California's Trash* study spent over $250,000 evaluating different methods to measure trash levels transported in flowing waterways during storm events. The study was conducted as a proof of concept and was not expected to generate reliable data on trash "flux" in water bodies. Study findings identified several constraints to conducting trash monitoring in flowing waterbodies during storm events, including the lack of suitable sites (e.g., bridges with access, permit for monitoring, nearby flow gauge), permitting, safety and costs. Additionally, the monitoring data collected was of limited use in answering questions about the transport of trash from one water body to another, mostly due to the constraints listed above. Therefore, because of the impracticality and high costs of collecting data that will likely be unusable and not assist BASMAA in answering MRP management questions, water column monitoring was not included in the BASMAA Trash Monitoring Program Plan. As an alternative to trash "flux" or water column monitoring, BASMAA member agencies will include quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons to better understand the utility of data collected from these monitoring locations to answer management questions outlined in the MRP. The number and location of trash booms that will be included in the Monitoring Program is currently under development and will be included in the Revised Monitoring Program Plan submitted to the Water Board EO for approval.	Add text describing the efforts that BASMAA has taken to-date to evaluate and test monitoring methods for measuring trash "flux", the lessons learned from these efforts, and the reasoning for not including it in the Monitoring Program Plan. Revise Plan to state that quantitative trash monitoring at existing trash booms will be included in the Monitoring Program. Add an SOP and field data collection form for quantification of trash at booms.
Refined Receiving Water Monitoring Questions numbers 1, 2 and 3, as presented in Table 2-3, cannot be adequately answered without water column data. This underlines the importance of working to collect that data.	We generally disagree. Monitoring questions similar to these were addressed via methods developed and utilized by the SF Bay Water Board (i.e., Rapid Trash Assessment) that did not include the collection of water column data. Furthermore, data collected using these methods focused on assessing the levels of trash deposited or present in receiving water bodies, were used to list many Bay Area urban creeks/rivers and shorelines on the 303(d) list of water quality impaired segments. Trash monitoring methods proposed by BASMAA are derived from the Water Board's Rapid Trash Assessment method and therefore should be able to adequately begin to answer these questions. Lessons learned from this type of monitoring will be incorporated into recommended method revisions that will be included in the final monitoring report. That said, BASMAA member agencies will include quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons as an alternative to monitoring trash in flowing water bodies during storm events. See additional information above.	See above revisions regarding the addition of trash booms to the Monitoring Program.

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Targeted sites are not proposed to be monitored during a wet season. The proposal does not include collection of quantitative data for the wet season at any targeted sites. Wet season data should be included as much can change at sites months after the wet season.	The PMT, peer reviewers and stakeholders agree that the primary method that should ideally be used to characterize trash levels in receiving water bodies is the qualitative visual assessment method. The method is practical to implement and is the most cost-effective data collection method currently available. Based on this agreement, the Monitoring Program is focused on conducting qualitative assessments. The main purpose of including quantitative monitoring in the Monitoring Program is to provide a foundation for qualitative assessments. This foundation should be based on correlations between the ranges of trash volumes observed per unit area at sites where qualitative assessments and quantitative monitoring is conducted in parallel. Data needed to evaluate and develop these correlations do not need to be collected during the wet season. Therefore, quantitative data are being collected at targeted sites during timeframes when trash cleanup events are safe to conduct and are already occurring. For these reasons, quantitative monitoring during the wet weather season was not included in the Monitoring Program. Adding this element would require significant additional resources to be expended by Permittees, with limited benefits that are already being addressed via quantification during dry weather at these sites.	No revisions.
Please consider adding qualitative observations of the general area outside the defined assessment areas to this guidance or the associated protocols. That is, the Plan anticipates that trash in the assessment areas may be coming from the adjacent receiving water. At the same time, a number of receiving areas are likely to be impacted by direct discharges associated with homelessness and illegal dumping. It may be helpful to understand, via a qualitative observation of the area surrounding the assessment area, whether direct discharges are an immediate source to the assessment area (e.g., whether there are accumulations of trash discharging down a streambank).	We agree. The identification of sources adjacent to, but outside of the defined assessment area will be included in the qualitative protocol. Only the sources that are observable and immediately adjacent to the assessment area will be documented. These sources and the associated locations will be delineated in the field on a map and indicated in the field notes.	Revise qualitative protocol and assessment forms to include identification of trash sources to the assessment area that are observed in adjacent land areas.
Since trash booms collect material from upstream, booms should be included as a pilot approach to develop a reproducible method for their use in	During the evaluation of sampling methods, BASMAA evaluated booms as monitoring locations. A description of this evaluation and the limitations associated with using booms as monitoring sites is described in Attachment 2 of the Monitoring Program Plan. In summary, a very limited number of trash booms currently exist in Bay Area	Revise Plan to include quantitative trash monitoring at existing trash booms.

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monitoring. If a location with a trash boom is monitored, quantitative monitoring is recommended.	creeks, rivers, sloughs and lakes (13, including 5 in Lake Merritt), making the use of booms as monitoring locations for all water bodies and watersheds in the Bay Area impossible. If Permittees attempted to deploy additional booms, the design and permitting for new trash booms at optimal locations would likely take over a year, which would further constrain data collection required by the MRP. Although we fear that the data may be of limited use because of site-specific considerations regarding the capture efficiencies of different booms and the maintenance methods used to remove trash from booms, BASMAA member agencies willing include quantitative trash monitoring at a portion of the existing trash booms currently deployed in creeks, lakes, sloughs and lagoons to better understand the utility of data collected from these monitoring locations to answer management questions outlined in the MRP. The urrently under development and will be included in the Revised Monitoring Program Plan submitted to the Water Board EO for approval.	Revise Plan to state that quantitative trash monitoring at existing trash booms will be included in the Monitoring Program. Add an SOP and field data collection form for quantification of trash at booms.
This number of ratings, including 5 sublevels in each category, seems likely to present challenges. Can the sublevels be consistently assessed across varied staff, events, and locations, such that they would be a consistent indicator of difference? It may simplify data collection and analysis to reduce the number of sublevels or omit them and use the four categories.	We agree that 5 sublevels for each category will be challenging to score consistently and may present challenges. The intent of the sublevels was to provide greater resolution in qualitative scores to allow comparison with quantitative data that will be collected in parallel.	SOP will be edited to reduce the number of sublevels under each category. We propose to have 3 sublevels under each category to allow for low, med and high scores to be assigned.
This proposal is acceptable if CEDEN can be effectively modified in time to meet program needs. However, it is unclear whether this can be accomplished. For example, CEDEN is not currently set up to accept photographic monitoring, and it is unlikely that will change during the current permit term.	BASMAA has extensive experience in working with the SF Bay Regional Data Center (i.e., SFEI) on incorporating monitoring data (of many types) into CEDEN. Additionally, CEDEN currently accepts receiving water trash monitoring data based on the Water Board's Rapid Trash Assessment method. Because the BASMAA proposed trash assessment method is similar to the RTA, we do not anticipate issues with modifying data fields and incorporating data collected through the BASMAA Monitoring Program Plan into CEDEN. Should issues arise and appear insurmountable, alternative methods will be used to allow for data collected to be made publicly available.	No revision.

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Data presentation can be further discussed and determined based on the data collected. The current means of data presentation, in the annual report and in Tracking California Trash, may be preferable to facilitate long-term data and trend analysis.	We agree, the Plan includes examples of data analyses that will be considered during the development of progress reports and monitoring reports required by the MRP. As indicated and similar to other stormwater and receiving water monitoring plans, the exact presentation of the data collected through the Trash Monitoring Program Plan cannot be defined prior to the data are collected and reviewed. We are happy to further discuss the most appropriate presentations of data collected through the Program once we begin development of the interim and final reports required by the MRP.	No revision.